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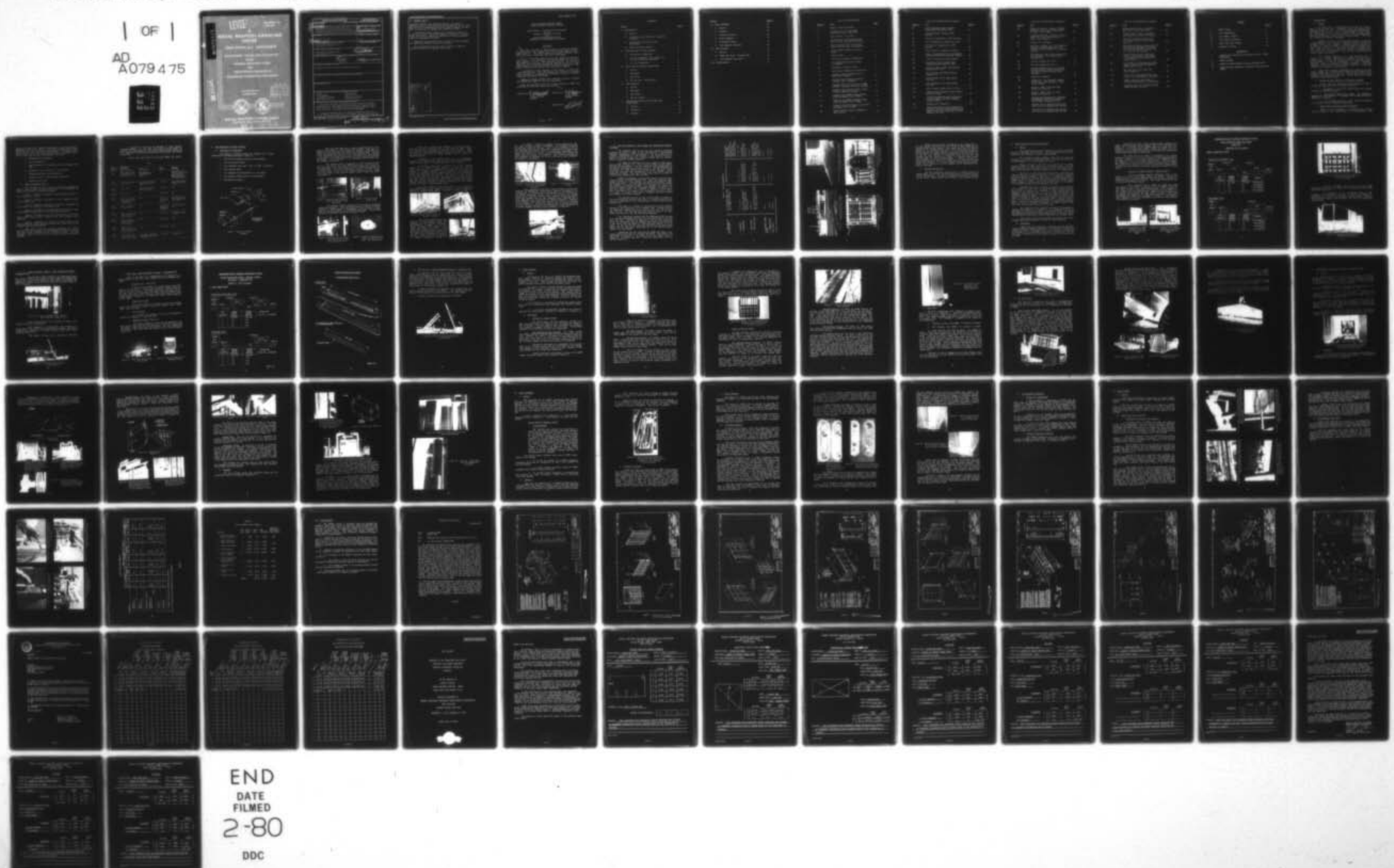

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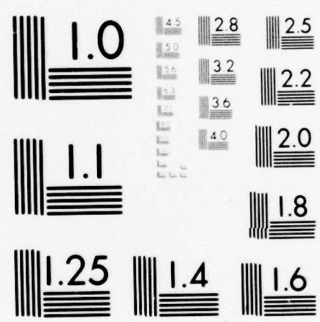
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OF AN
INTERNAL RESTRAINT SYSTEM
FOR
TRANSPORTING ORDNANCE IN
COMMERCIAL INTERMODAL CONTA

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes an Internal Restraint System Kit (IRSKIT) developed for use when transporting ordnance within commercial intermodal containers. The IRSKIT consists of reusable mechanical components to be used in conjunction with wooden bulkheading.

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A successful overseas shipment of live ordnance is herein described and discussed. This trial shipment was conducted as an operational evaluation of equipment and procedures and also to determine supportive requirements for IRSKIT.

Additional testing confirms that intermodal containers equipped with IRSKIT meet ANSI/ISO structural requirements.

Data and procedures from time studies conducted at NWHC and during the overseas trial shipment are included.

NAVAL WEAPONS STATION EARLE
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DEVELOPMENT, TESTING AND EVALUATION OF AN INTERNAL RESTRAINT SYSTEM FOR TRANSPORTING ORDNANCE IN COMMERCIAL INTERMODAL CONTAINERS

ABSTRACT

This report describes an Internal Restraint System Kit (IRSKIT) developed for use when transporting ordnance within commercial intermodal containers. The IRSKIT consists of reusable mechanical components to be used in conjunction with wooden bulkheading.

Testing of prototype units has shown that IRSKIT can safely restrain ordnance when subjected to the testing specified by two cognizant regulatory agencies. Both regulatory agencies, the Bureau of Explosives of the Association of American Railroads and the U.S. Coast Guard Division of Hazardous Materials have granted approval for shipments of three types of ordnance when restrained by IRSKIT.

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I. BACKGROUND

A. General

In recent years, containerization has become the dominant mode of the merchant fleet. Breakbulk vessels and shipments have declined steadily. In order to meet possible contingency requirements, the military services must adapt to containerization. Without adaptation, the military faces the consequence of increasing incompatability with the more efficient technology of the shipping industry. This could be a critical factor during a contingency.

Among the concerns of containerizing shipments of ordnance is that regulatory agency approval is required for the procedures and equipment used for cargo restraint. Cognizant regulatory agencies are the Bureau of Explosives (BUEX) of the Association of American Railroads (AAR), and the U.S. Coast Guard Division of Hazardous Materials. Each has established criteria for restraint of hazardous cargo for their mode of transportation. These are more fully described in a later section of this report.

When shipping ordnance in U.S. Army MILVAN's, the restraint is not a problem. MILVAN's have provision for an approved restraint system. However, the number of MILVAN's available is limited and insufficient to meet the requirements of a major contingency. Therefore, reliance on commercial containers is mandatory. Since these containers do not have a built-in restraint capability, an acceptable technique and hardware must be developed.

This report discusses development and testing of one such system, IRSKIT, by the Naval Weapons Handling Center (NWHC), Naval Weapons Station Earle, Colts Neck, NJ. This system evolved from observations and data derived from prior concepts which were formally described in other NWHC reports.

B. Internal Restraint Methods for Commercial Containers

To date, the most successful restraint methods in terms of testing and demonstration may be classified as follows:

1. Installation of perforated sidewall panels and crossbars (parallels the MILVAN technique).

2. Conventional blocking and bracing. This technique is dependent on tight tolerance of dunnaging with varying internal configurations of containers.

3. Use of readily procured or short lead time components to be attached to proven container strong points.

C. Goals-Oriented Restraint System Development

NWHC, in the development of a restraint system that conformed to Method 3 above, had defined a set of design goals. These

goals are oriented toward realistic considerations in times of emergency mobilization, and are in addition to the demonstratable ability to meet BUEX and U.S. Coast Guard Test Requirements. The following goals are not listed in any order of priority since each is considered a must. Failure to meet any one goal would disqualify the design.

1. Minimum time for installation
2. Low acquisition cost
3. High probability of compatibility with all containers and loads
4. Reusability (or cost effective, if not reusable)
5. Minimum instruction and documentation
6. Readily procured or short leadtime components
7. Minimum time to stuff

D. NWHC Development Efforts

The following are some of the basic approaches evaluated by NWHC in order to meet the goals listed above. The AAR/BUEX rail impact test procedure was followed throughout.

Type 1. Adhesive attachment of steel strapping anchors to the container floor or walls.

Type 2. Mechanical attachment of steel strapping anchors to the container floor.

Type 3. Mechanical attachment of both steel strapping and steel restraint rods anchored to the container floor.

Type 4. Attachment of two restraint rods to the front upper corner fittings combined with steel strapping (floor anchored).

Type 5. Attachment of two steel restraint cables to the front corner posts (upper region) combined with steel strapping (floor anchored).

Type 6. Attachment of four steel restraint cables to the front corner posts (upper and lower regions) and a composite wood and aluminum angle restraint bulkhead.

While most of the above produced satisfactory test results, the first five had deficiencies or shortcomings with regard to the design goals which precluded further development efforts. The final prototype, (Type 6) is the basis of this report and will be described in detail.

It should be noted that the feasibility of using container structural members (i.e., the front corner posts and wall panel) for restraint was demonstrated in a full scale container corner fitting pull test. Appendix I is included which describes the procedure and results of this test.

Table I lists the results of the relevant NWHC test reports.

TABLE I

NWHC REPORT NO. AND DATE	DESCRIPTION BASIC SYSTEM (REFER TO PARA I.D.)	TEST CONFIGURATION	TEST RESULTS	ADDITIONAL INFORMATION
N/A NOV 74	TYPE 1: Adhesive; Two-Part, Structural (steel strapping bonded to container walls)	None completed, MK 82 Bombs Modified MILVAN (beltrails removed)	N/A	Proper adhesion not attained. Requires long curing time; critical to ambient temperature, humidity and condition of attaching surface.
7516 28 FEB 75	TYPE 2: Floor Stringers, Steel Strapping	MK 82 Inert Bombs 36000# Modified MILVAN (beltrails removed)	Satisfactory	Steel strapping awkward during installation and loading.
7537 25 APR 75	TYPE 2: Same	MK 82 Inert Bombs 36000#, Commercial Container	Satisfactory	Same
7537 30 JUN 75	TYPE 2: Same	Same	Satisfactory	Same
7590 6 OCT 75	TYPE 3: Floor Anchors/ Steel Strapping; Floor Fixtures/Restraint Rods, Hold Down Tubes	Same	Failure of floor at the restraint rod fixture	Improved handling of steel strapping. Some loss of cube.
7613 10 MAR 76	TYPE 3: Improved Restraint Rod Fixture	Same	Satisfactory, Minor End Gate Damage; Minor Load Shift	Satisfactory 80° Tilt Test
7645 2 JUN 76	TYPE 4: Corner Fittings (Upper)/Tie Rods; Floor Anchors/Strapping	Same	Satisfactory	Two additional impacts at 10 MPH
7695 29 NOV 76	TYPE 5: Corner Post (Upper) Attachment/Wire Rope Cables; Floor Anchors/Strapping	Same	Satisfactory	None
7711 4 MAR 77	TYPE 6: Corner Post (Upper and Lower) Attachments/4 Wire Rope Cables; 2 Structural Angles	Same	Satisfactory	None
7749 3 AUG 77	TYPE 6: Improved Corner Post Attachments; Full Height Structural Angles	Three Commercial Containers; MK 82 Bombs, 105 MM Ordnance, 155 MM Projectiles	Satisfactory	NWHC COFC Tests

II. THE RESTRAINT SYSTEM (IRSKIT)

A. Description of Components

The lading is restrained within the container by a system consisting of the following components (Figure 1):

1. Four 5/8 inch diameter steel wire rope assembly.
2. Four steel anchor blocks.
3. Four threaded steel rods 1 inch x 8 UNC x 48 inches.
4. Four back-up plates.
5. Two aluminum structural angle 8 L 2 x 85 inches.
6. Two spherical washer pairs (or swivel fittings).
7. Miscellaneous hardware.

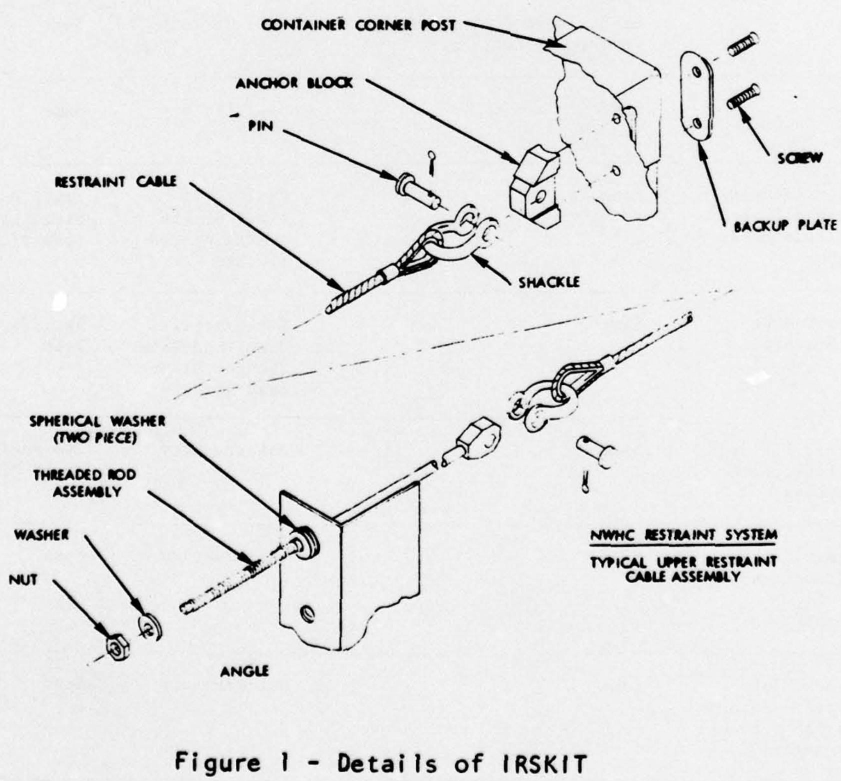


Figure 1 - Details of IRSKIT Hardware

Each structural angle has a series of predrilled holes for the purpose of attachment to the restraint cable assembly. Each upper restraint cable and threaded rod assembly is installed through that hole which lies immediately above the level of the ordnance load. Selection of the appropriate hole results in the restraining forces being applied at the location of maximum effectiveness for a wide range of cargo lading heights. This is illustrated in the installation and container loading drawings of Appendix II.

The spherical washer arrangement (or swivel fitting) provides the nut at the end of each upper threaded rod with a flat bearing surface regardless of the angle which the cable assembly may assume due to lading height. The swivel fittings were used for the COFC rail impact test series at NWHC and are shown in Figures 2 and 3. These were superseded by the spherical washers before transit from NWHC to Savanna, IL.

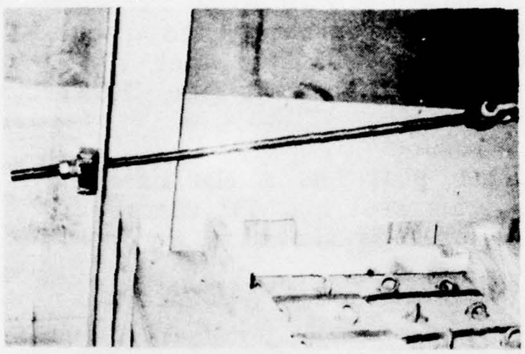


Figure 2 - Restraint Rod, Structural Angle and Swivel Fitting (Side View)

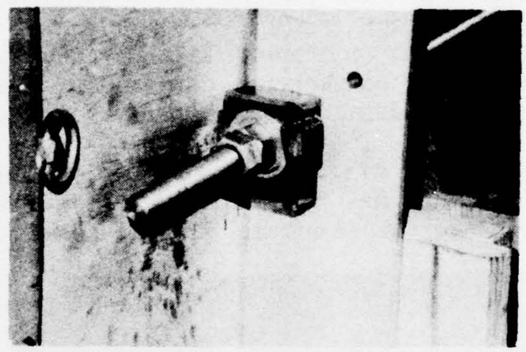


Figure 3 - Swivel Fitting (Front View)

The spherical washers remained in use during all subsequent testing and evaluation. Since spherical washers are capable of compensating for a limited amount of misalignment, it was necessary to spotface the structural angles to an additional small angle. The spherical washers and installation are shown in Figures 4 and 5.

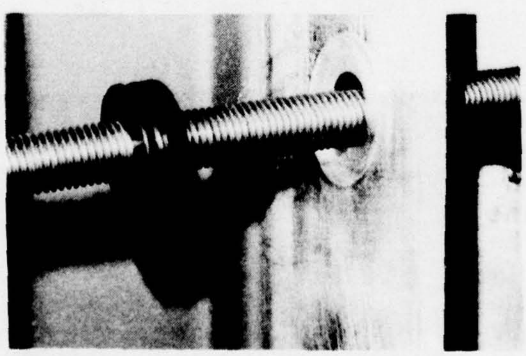


Figure 4 - Restraint Rod, Structural Angle and Swivel Fitting With Angled Spotfacing

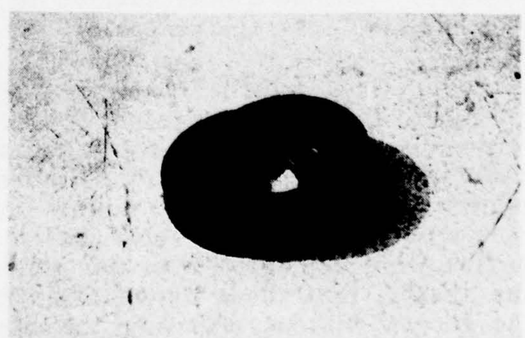


Figure 5 - Spherical Washer Pair As Used With Upper Restraint Rods - (All Containers)

Each lower restraint cable assembly is installed through a single hole located at the lower end of each structural angle. There is no alternate hole installation for the lower cable assemblies. Since the lower cable assemblies will always be horizontal, there is no need for alignment devices such as swivel fittings, spherical washers or angular spotfacing.

Attachments to the container corner posts are accomplished by means of the anchor blocks, back-up plates and countersunk screws. Anchor blocks coupled to restraint cables are shown in Figure 6.

The back-up plates were re-designed to present a minimal addition to the container exterior envelope. Initially, two types of plates were employed to correspond to specific corner post cross sections of containers obtained for the development. Both types of plates were fabricated from the same material and were identical in overall dimensions and hole spacing. The contour or cross section was the only difference in order to be compatible with these two common corner posts cross sections. From prior observation and discussion with container industry personnel it was estimated that 70% of existing commercial containers would be compatible with the IRSKIT concept using either of these back-up plates.

One cross section of the corner post has a flat exterior. The original back-up plate designed for this post had 45° chamfer all around to eliminate sharp edges. This plate is shown in Figure 7.

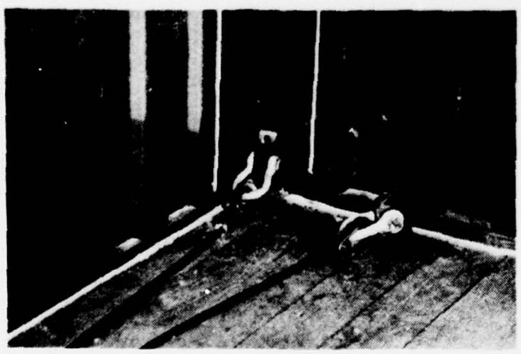


Figure 6 - Anchor Blocks Coupled To Restraint Cables

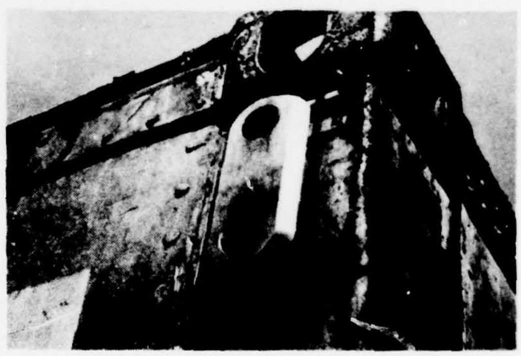


Figure 7 - Back-up Plate

The second back-up plate was intended for the irregular corner post commonly used with all-steel containers. Measurement of a number of these containers established the angles of the recess sides were 35° and 45°. Those angles were machined onto the plates with the results that these plates could fit into the recess without effecting the container envelope. This corner post is shown in its original configuration (Figure 8).

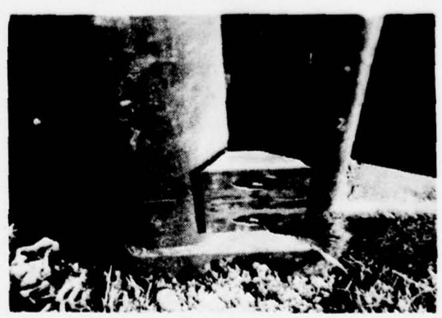


Figure 8 - Corner Post (Original Configuration)

In order to reduce the number of parts required for each kit, while ensuring container compatibility, an elongated combination of these two plates was devised. This is shown installed on the all steel container and with the original flat corner plate in Figures 9 and 10. The dual-sided plates were used exclusively subsequent to the NWHC COFC tests (i.e., transit, all AMC SAVANNA tests, NWHC time study, and the overseas trial shipment). For a further discussion of both container cell clearance and corner post/back-up plate compatibility, Section VI, paragraph E.

Figure 9 - Dual-Sided Back-Up Plate Installed On Irregular Cornerpost

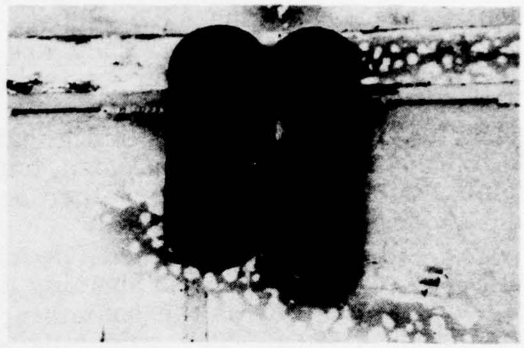


Figure 10 - Comparison of Back-Up Plates

After completion of the COFC testing at NWHC on 18 May 1977, DARCOM and MERADCOM representatives requested installation of instrumentation to determine certain characteristics of the restraint system during subsequent testing. One of these would be the dynamic loading of the individual restraint cable assemblies during rail impacts. Load cells normally used for this application were unsuitable due to space limitations and requirements for adaptive hardware. Therefore, as an alternate, strain gages were bonded to the rods in the unthreaded area (Figure 11). The dynamic load in each rod during rail impact tests was thereby determined by measuring the strain (elongation) in a constant diameter rod with a known coefficient of elasticity.

Figure 11 - Strain Gages Installed On Restraint Rods

B. <u>The Test Containers, Inert Lading, and Blocking and Bracing (Dunnage)</u>

The containers used in this test were commercial intermodal containers as listed in Table II and manufactured to International Standards Organization (ISO) specifications. The test lading of inert ordnance corresponding to each container is also listed in Table II. Figures 12 through 15 depict the container loading area and container interiors during the stuffing operations.

The 105MM and 155MM unit loads were supplied by AMC Ammunition Center, Savanna, IL. These represent lading of high density and high and low profile. They are exactly the same configurations as selected for evaluating other restraint systems. The MK 82 Bombs are an example of a high density and medium profile unit load. These bombs had been the sole configuration in all other IRSKIT concept evaluations at NWHC. This load had also been involved in other restraint system evaluations by other activities.

IRSKIT was designed, developed and tested to primarily withstand the rigors of railcar humping tests. Since such loads are longitudinal with respect to the container, the system was designed to withstand tensile forces. The main bulkheads which contact the test lading, are designed to withstand bending. The blocking and bracing was planned to maintain separation and minimize shifting or movement of the unit loads during transit. The capability of IRSKIT to restrict movement or shifting of the lading in the longitudinal direction is judged to be high. It should be noted that no "tomming" was used in any of the containers for vertical restraint.

An additional function of that bracing which is located between the lading and container side walls is to distribute lateral forces (as may be encountered in the rolling motion on board a ship) onto the container wall.

The ability of a container to withstand lateral forces primarily depends on the construction of the container itself. Another factor is the sidebracing installed in order to distribute the load over the adjacent wall area. The following discussion addresses some of the significance and features of the side wall bracing employed.

The sidebracing installed with the 105MM approaches the ideal of a uniformly distributed load onto the wall panels more so than the other test loads. Referring to Figure 14, it can be seen that lateral forces are transmitted onto the sidewall panel close to its connection to the bottom side rail which is a main structural member of a container. In the top side rail area, the lateral forces are again transmitted onto the wall panel, distributed by the two upper horizontal boards of the sidebracing.

Sidebracing was also used with the 155MM test lading to distribute lateral forces into the container wall panels. The height of the sidebracing corresponded to the height of the test lading. Refer to Figure 15. No attempt was made to distribute lateral forces over the full wall panel area.

TABLE II. TEST CONFIGURATIONS

1. IDENTIFICATION AND TEST USAGE	CTI S/N 261469 (NWHC; COFC) CTI S/N 068878 (Savanna; All Tests, NWHC; Time Study)	NWHC SNC-49834 (All Tests)	CTI S/N 041689 (NWHC; COFC) CTI S/N 251425 (Savanna; All Tests) CTI S/N 251328 (NWHC; Time Study and Structural Tests)
2. DIMENSIONS	8' x 8' x 20'	8' x 8'6" x 20'	8' x 8'6" x 20'
3. CONSTRUCTION	Steel Frame, Aluminum Panel Exterior, Plywood Panel Interior, Aluminum Roof, Wood Flooring	Steel Frame, Fiberglass Reinforced Plywood Walls and Roof, Wood Flooring	Steel Frame, Corrugated Steel Walls, Steel Roof Wood Floor
4. WEIGHT (EMPTY)	4,000 lb.s	4,350 lb.s	5,140 lbs.
5. INERT TEST LADING	Army 155 MM Projectile, 8 Proj/Unit Load, 42 Unit Loads @ 800 lb. Total 33,600 lb.	Army 105 MM Projectile 30 Proj/Unit Load, 20 Unit Loads @ 1,916 lb. Total 38,200 lb.	Navy MK 82 Bombs (MHU/122 Pallets) 6 Bombs/Unit Load 12 Unit Loads @ 3,000 lb. Total 36,000 lb.
6. RESTRAINT SYSTEM WEIGHT	500 lb.	500 lb.	500 lb.
7. DUNNAGE WEIGHT	1,100 lb.	1,225 lb.	1,560 lb.*
TOTAL WEIGHT	39,200 lb.	43,775 lb.	43,200 lb.

*Includes Side Bracing and Front Panel Adapter

Figure 12 - Container During "Stuffing" Prior To COFC Tests at NWHC

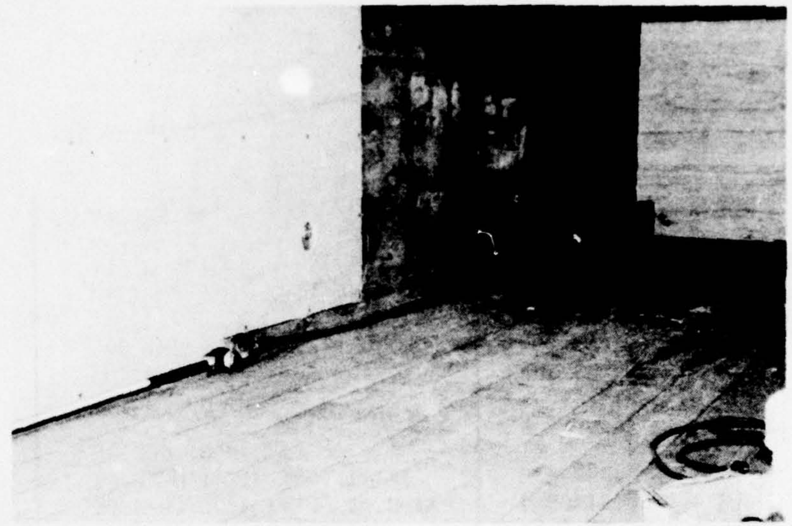


Figure 13 - Restraint Cable Assembly Installed In Container Prior To "Stuffing"

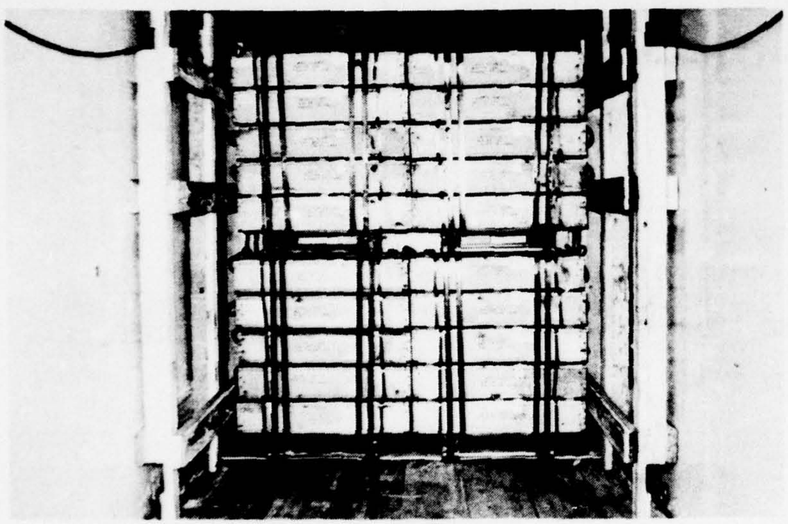


Figure 14 - Container With Four Unit Loads Of 105MM Ordnance, Restraint System and Dunnage

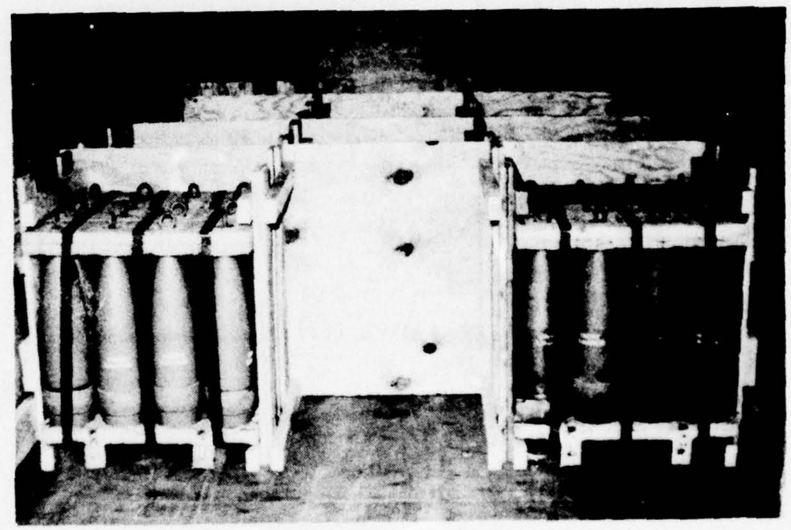


Figure 15 - Container With Restraint System, Partial Projectile Lading and Dunnage

Having been previously designated as the configuration to test wall strength during the tilt test, the MK 82 Bomb lading was not provided with any side bracing. Since lateral forces are not induced, deletion of the sidewall bracing was of little consequence for the rail impact tests of both COFC and TOFC; nor was it of great significance for the amount of sidewall loading encountered in the road tests. In the 80° tilt tests, deletion of sidebracing would not only test wall strength, but also determine the ability of a tensioned cable system such as IRSKIT to reduce sidewall loading. In theory, four fully tensioned members can compress the lading into one rigid mass between the two end bulkheads. In practice, complete rigidity was not attained, mainly due to compression of wood dunnage and the dimensional tolerances of unit loads.

C. Container Modification

The only modification required prior to stuffing consisted of drilling eight 7/8 inch holes in the corner posts at the front (closed) end of the container. The holes accommodate the terminal connections (anchor blocks, backup plates and screws) of the restraint system.

III. TEST AND EVALUATION PROCEDURES

A. General

The standardized procedures employed to evaluate the IRSKIT system are described in this section. These procedures have also been followed for the evaluation of other restraint systems.

The procedures reflect conditions which the test article will encounter in an actual operating environment. This includes all aspects of intermodability, (i.e., rail, highway and marine).

Whereas extremes of rail and road transport can be readily simulated, high sea states aboard a containership cannot. This has been resolved by use of the 80° sideways tilt test as the approval criteria by the Division of Hazardous Materials of the U.S. Coast Guard.

Since it is a static test and far beyond the recoverable roll angle for any type of ship, the 80° tilt test is not intended to simulate an actual shipboard condition. However, it is estimated to produce a margin of safety over an equivalent dynamic sidewall loading of anticipated lesser roll angles. The margin of safety would cover factors such as fatigue or deterioration due to repeated rolls, possible damage to the container during in-transit handling, and others.

Regarding the other test modes, containers may be transported by rail in two ways; first, as containers directly attached to flatcars (COFC) or secondly, as containers on trailer chassis which are attached to the flatcar (TOFC). It has not been determined if any significant difference exists between the two modes in the forces encountered during rail impacts. It would be beyond the scope of this report to speculate on this topic due to the number of factors involved. Also, it is within the realm of possibilities that a container with restraint system could be transported both ways during the same shipment. In order to establish that IRSKIT is a viable system in TOFC and COFC, the containers were tested both ways.

The rough road test, described in Section III, Paragraph C, reduces the necessity for driving the test configurations over the equivalent of many miles of normal or less severe roads. The hazard and washboard courses assure that specific motions of containers will be obtained thereby inducing the desired loading into the restraint system.

The results of the test procedures are found in the corresponding alphabetized paragraph of Section IV, TEST RESULTS.

B. Rail Impact

These tests were conducted in accordance with MIL-STD-1325, "Railcar Loading of Hazardous Materials," which requires a total of four impacts into a line of stationary buffer cars. Three of the impacts are at velocities of 4, 6 and 8 MPH on one end of the impact car. The impact car is reversed and the final impact is made into the buffer cars at 8 MPH.

The buffer cars are a series of empty boxcars (minimum total weight, 250,000 pounds) coupled without slack in the draft gear and brakes set. The impact car is propelled toward the buffer cars by a locomotive. At the approximate impact velocity the impact car is uncoupled from the locomotive and allowed to roll freely for approximately 75 feet before impact into the buffer cars.

The actual velocity of impact is determined by two switches installed at each end of an 11 foot section of track immediately before the point of impact. The switches, actuated by the leading wheels of the impact car, activate an elapsed time recorder. Recorded elapsed time readings are then converted to velocities in miles per hour (MPH). The doors of the containers are secured in their fully opened position in order that any movement of the test loads may be observed on each impact.

1. Container On Flatcar (COFC) - NWHC 18 May 77

The test containers loaded as indicated in Table III were placed on a 90 foot TTCX railway flatcar, SN 976080. This car was equipped with a cushioned drawhead and had tie-down provisions to secure ISO containers to the car bed. Total weight of the buffer cars was approximately 260,000 pounds.

The containers with the 105MM and 155MM test lading were placed on the flatcar, as shown in the test syllabus (Table III) and Figures 16 and 17, and tested simultaneously. After completion of that series, those two containers were removed from the impact car. The container with the MK 82 Bombs (Figure 18) was then placed on the flatcar and underwent the same series of impacts. High speed photography was utilized for recording the 8 MPH ("A" END) impacts. After completion of the COFC rail impacts, the contents of all containers were removed and inspected.

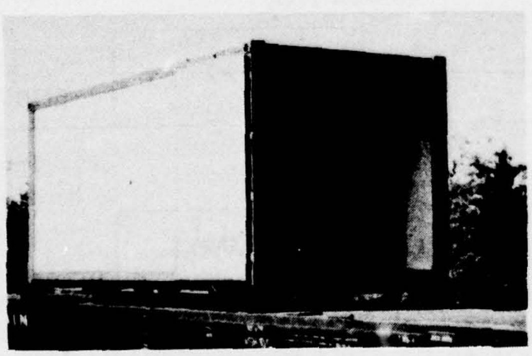


Figure 16 - Container With 105MM Ordnance During COFC Rail Impact Tests At NWHC

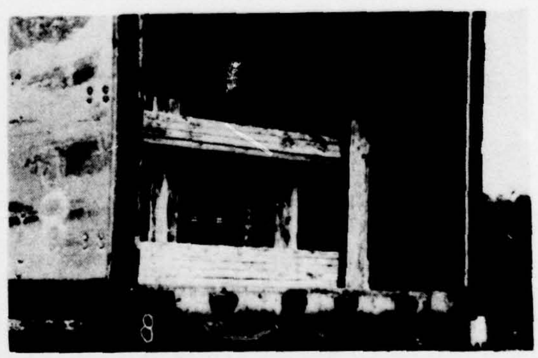


Figure 17 - Container With 155MM Projectiles During COFC Rail Impact Tests At NWHC

DEMONSTRATION OF INTERNAL RESTRAINT SYSTEM

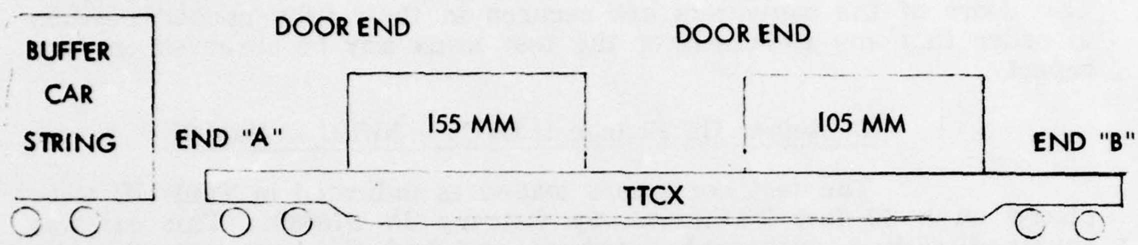
NAVAL WEAPONS HANDLING CENTER

18 May 1977

TABLE III- TEST SYLLABUS

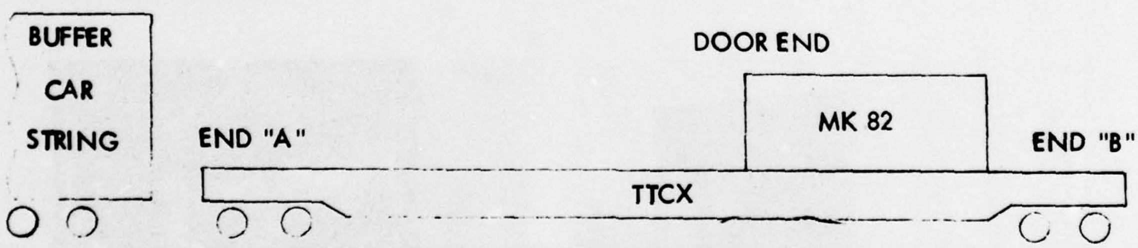
Railcar Impact Tests (COFC)

105 MM AND 105 MM INERT LOADS



END IMPACTED	DESIRED IMPACT VELOCITY	ACTUAL IMPACT VELOCITY	REMARKS
A	4.0 MPH	4.75 MPH	NO DAMAGE
A	6.0	6.4	NO DAMAGE
A	8.0	8.8	NO DAMAGE
B	8.0	8.8	NO DAMAGE

MK 82 INERT LOADS



END IMPACTED	DESIRED IMPACT VELOCITY	ACTUAL IMPACT VELOCITY	REMARKS
A	4.0 MPH	4.4 MPH	NO DAMAGE
A	6.0	6.6	NO DAMAGE
A	8.0	8.8	NO DAMAGE
B	8.0	8.8	NO DAMAGE

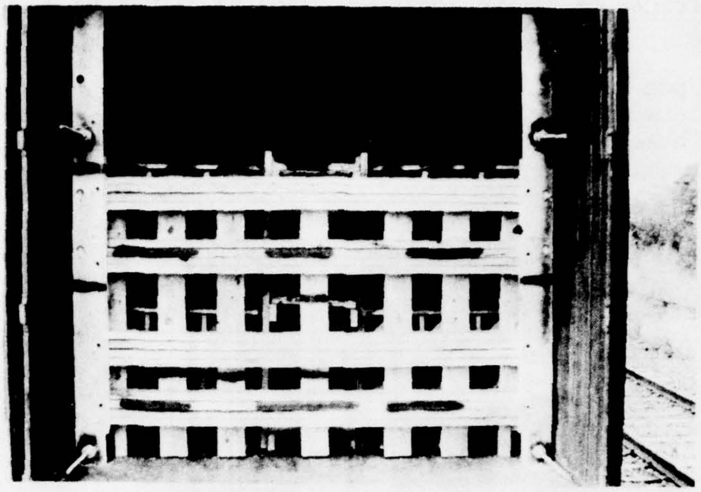


Figure 18 - Container With MK 82 Bombs
During COFC Rail Impact
Tests At NWHC

All three containers were placed on the same railcar used during the COFC tests (Figure 19) and shipped via rail to AMC SAVANNA, Savanna, IL.

In preparation for the subsequent testing at AMC SAVANNA, the replacement components as described in Section II, paragraph A (dual sided back-up plates, spherical washers, and spot-faced aluminum angles) were reinstalled, as were the instrumented restraint rods.

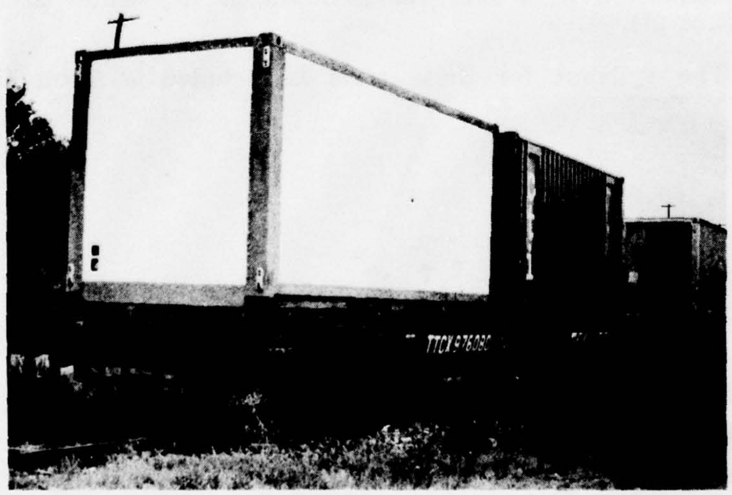


Figure 19 - Loaded Containers Prior To
Shipment To AMC Savanna

2. Trailer on Flatcar (TOFC) - AMC SAVANNA 30 August - 1 September 1977

Upon arrival at AMC SAVANNA, load displacement gages were installed between each restraint system angle and container wall (Figure 20). These were installed for the purpose of measuring the longitudinal movement of the test loads within the container during the TOFC rail impacts.

Figure 20 - Load Displacement Gauge Installed Before TOFC Rail Impact Tests

The testing procedure was essentially the same as described in Section III, paragraph B.

The containers on trailer-chassis were mounted on a trailer flatcar (TTX 155063) with non-cushioned coupling. The instrumentation was connected to a recorder mounted in the center area of the flatcar (Figure 21).

The syllabus for these tests is included as Table IVA.

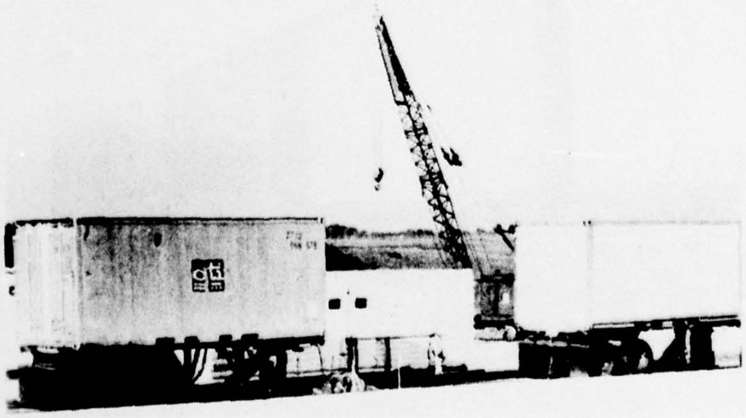


Figure 21 - TOFC Rail Impact Testing At AMC Savanna

C. Road Tests - AMC SAVANNA 30 August - 1 September 1977

Each of the three test configurations were mounted on a trailer chassis and pulled by tractor (Figure 22) for the following road testing:

1. Hazard Course (Table IVB)

A 200 foot long segment of concrete paved road which consists of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed twice at this time. Each test configuration was driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 MPH).

2. Rough Road Course

This course consists of 30 miles of travel over available rough roads consisting of gravel, concrete and asphalt, curves, cattle gates, stops and starts.

3. Hazard Course

An additional two traverses of the course described in Section III, Paragraph C.1. and Table IVB.

4. Washboard Course (Table IVC)

This course comprises a 300 foot long segment of concrete paved road which has rails spaced on 26-1/2 inch centers and protruding 2 inches above the road surface. The test configuration was driven at the speed which will produce the most violent response (Figure 23).

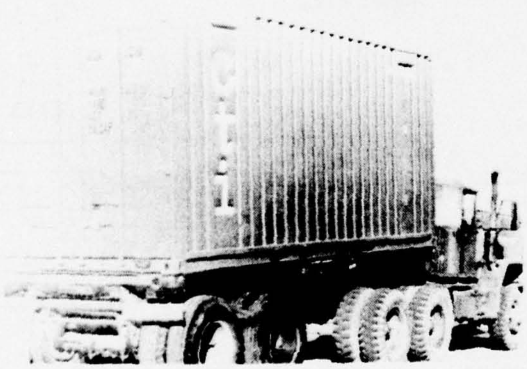


Figure 22 - Road Test Configuration At AMC Savanna

Figure 23 - Test Configuration On Washboard Course

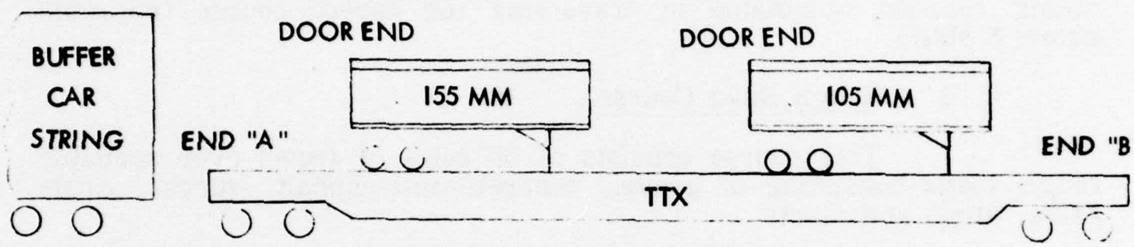
DEMONSTRATION OF INTERNAL RESTRAINT SYSTEM

Darcom Ammunition Center, Savanna, Illinois
30 August - 1 September 1977

TABLE IV - TEST SYLLABUS

A. Rail Impact (TOFC)

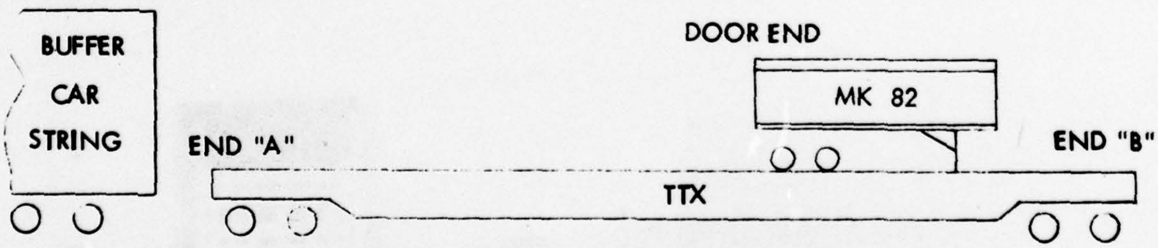
<u>105 MM AND 105 MM INERT LOADS</u>



END IMPACTED	DESIRED IMPACT VELOCITY	ACTUAL IMPACT VELOCITY
A	4.0 MPH	3.68 MPH
A	6.0	6.52
A	8.0	8.72
B	8.0	8.57

BUFFER CARS:
TOTAL WT.; 227,900 LBS.

<u>MK 82 INERT LOADS</u>



END IMPACTED	DESIRED IMPACT VELOCITY	ACTUAL IMPACT VELOCITY
A	4.0 MPH	4.21 MPH
A	6.0	5.58
A	8.0	8.45
B	8.0	8.62

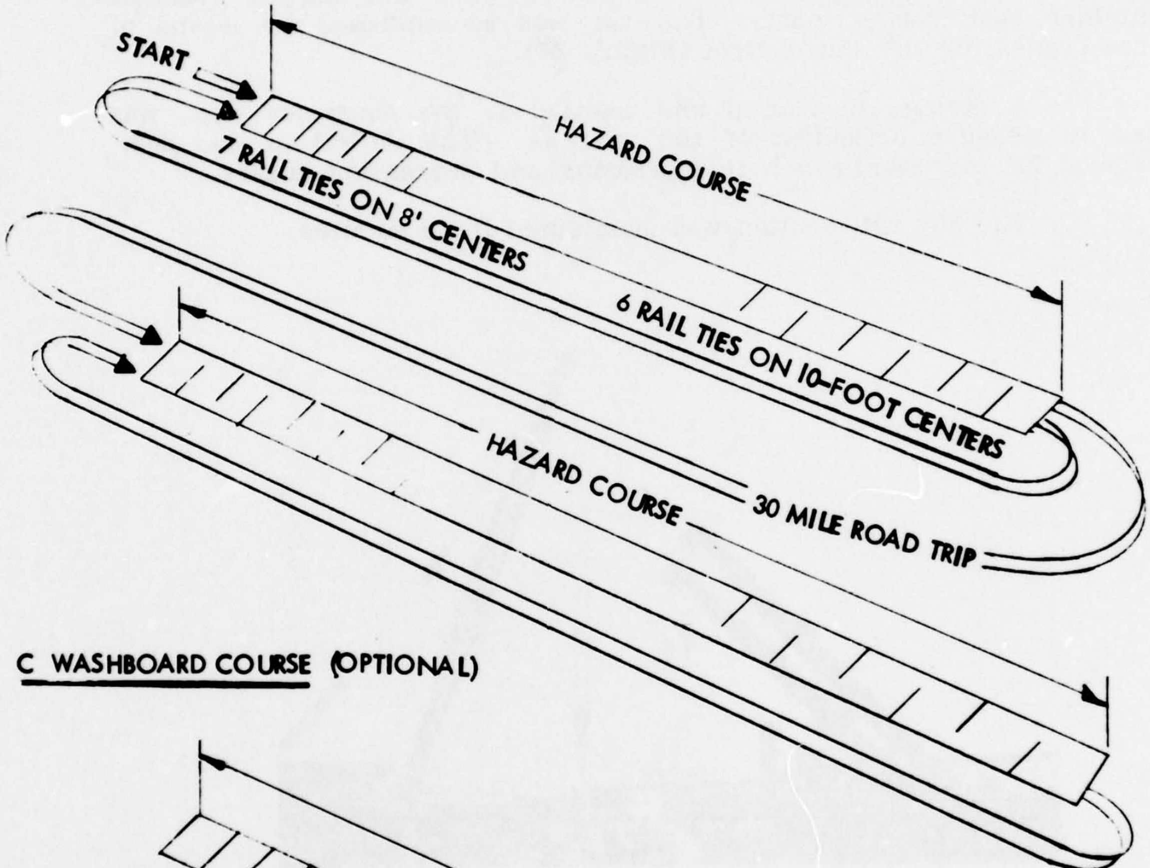
BUFFER CARS:
TOTAL WT.; 227,900 LBS.

SHEET 1 OF 2

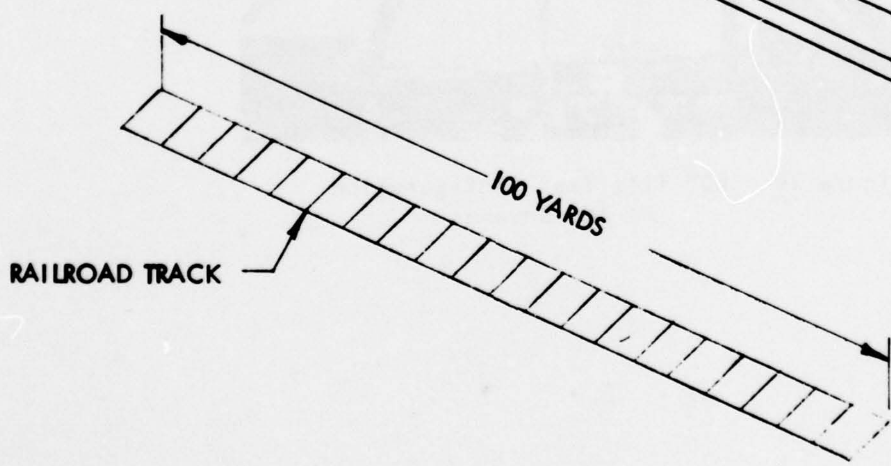
DARCOM AMMUNITION CENTER

Transportability Road Course

B ROAD TEST



C WASHBOARD COURSE (OPTIONAL)



SHEET 2 OF 2

D. 80° Tilt Tests - AMC SAVANNA 30 August - 1 September 1977

As required by the U.S. Coast Guard, the three test configurations were subjected to the 80° sidewise tilt test. These tests were conducted after completion of all the preceding tests. Each container was removed from its trailer chassis and positioned on two railroad ties on level ground. The left container door was closed and secured. A large protractor was affixed to the railroad ties and aligned with the container rear corner post. The tilt was accomplished by means of three cranes for tilt and control (Figure 24).

A string, horizontal and parallel to the container wall, was used to measure deflection of the sidewall. The deflection was measured at 10° increments in both increasing and decreasing angles.

The 80° tilt position was maintained for 5 minutes.

Figure 24 - 80° Tilt Test Configuration
At AMC Savanna

IV. TEST RESULTS

A. General

The testing in this report was directed toward gaining regulatory agency approval for shipments utilizing the IRSKIT system. Representatives of these agencies required minimal data during the performance of the tests. Their decision was based on observation and careful examination during and after the prescribed testing.

The ability of IRSKIT to provide restraint to hazardous lading is as important as its effect or interaction with the intermodal container. The container, with IRSKIT installed, must be capable of functioning as though the restraint system were not present. The container must be capable of retention of lading, interfacing with standard handling equipment, and unstuffing and possible restuffing. For these reasons, the following observations address the container as well as the restraint system and lading.

Also noteworthy is the amount of testing and shipment which the three test configurations have undergone and completed satisfactorily.

Data acquired from instrumentation installed at the request of DARCOM and MERADCOM is enclosed for reference as Appendix III.

B. Rail Impact

1. Container on Flatcar (COFC)

The TTCX flatcar, the ISO Containers, restraint systems, and test lading were inspected after each impact for damage or loss of integrity. The four impacts which constituted the rail impact test resulted in negligible shifting of the test lading. The following summarizes the observations for each test configuration:

The Aluminum Exterior Container, CTI 261469, packed with 155MM Projectiles remained tight and secure during and after the tests. However, as a result of the impacts in the direction toward the open end of the container, the vertical line of rivets securing the aluminum skin to the rear corner posts sheared, causing the skin to ripple. No other damage was noted on the container or projectiles.

Subsequent investigation has established that the installation of the restraint system was not responsible for this damage. This damage has been frequently observed on other containers of this type regardless of the internal load configuration.

Another instance of rivet failure occurred in CTI 068878 during subsequent testing at AMC SAVANNA (Figure 25).

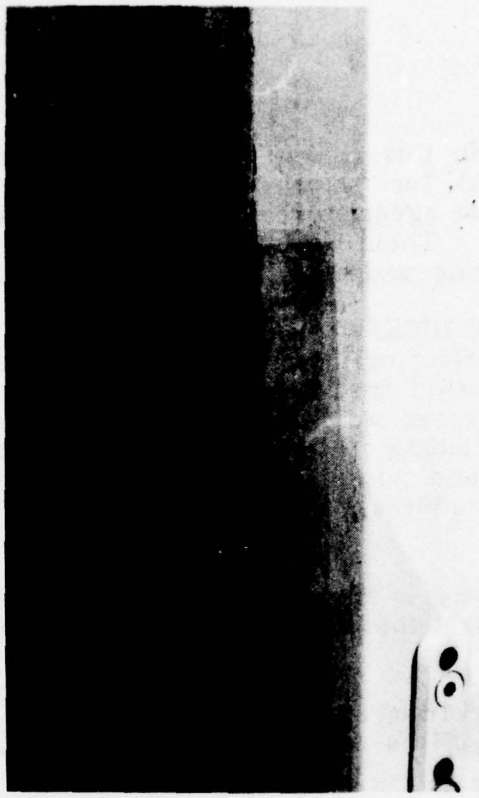


Figure 25 - Rivet Failure On
Aluminum Container

These rivet failures are examples of electrolytic corrosion between dissimilar metals; i.e., aluminum rivets and steel corner posts. Mylar tape is sandwiched between the aluminum skin panels and the corner posts to prevent corrosion, but it is impossible to provide a corrosion barrier under rivets.

<u>The FRP Container</u>, SNC-49834, packed with 105MM, remained tight and secure during and after the tests. There was no visible damage to the container or the inert lading.

<u>The All-Steel Container</u>, CTI 041689, packed with MK 82 Bombs, remained tight and secure during and after the tests. However, the container forward wall panel and corner posts bowed out approximately 1 inch due to contact with, and deflection of the transverse beams of the forward bulkhead assembly. There was no other damage to the container or inert lading.

The noted damage occurred during the impact toward the "B" (closed) end at 8.8 MPH. It should be noted that the restraint system has no load carrying capability in the direction of the closed end due to usage of wire rope cables. Therefore the closed end structure must be capable of withstanding the forces of impact in that direction. However, the forces imparted to the closed end during a rail impact test were in excess of the applicable design requirements for a container end wall.

A duplicate test configuration, (with a redesigned forward-bulkhead section) was subsequently tested with no discernible damage to the closed end wall and corner posts. The forward bulkhead was retained, but an adapter was fabricated. This adapter was placed between the bulkhead and the container front wall and corner posts (Figure 26). The adapter was designed to conform to the container front wall contours and to distribute the force of impact over the maximum front wall panel and corner post area. The combined bulkhead assembly and adapter has approximately three times the bearing area of the original bulkhead.

The testing of this bulkhead consisted of impacts toward the closed end at 4, 6, 8 MPH and impacts toward the open end at 8 MPH which were followed by another impact toward the closed end at 8 MPH.

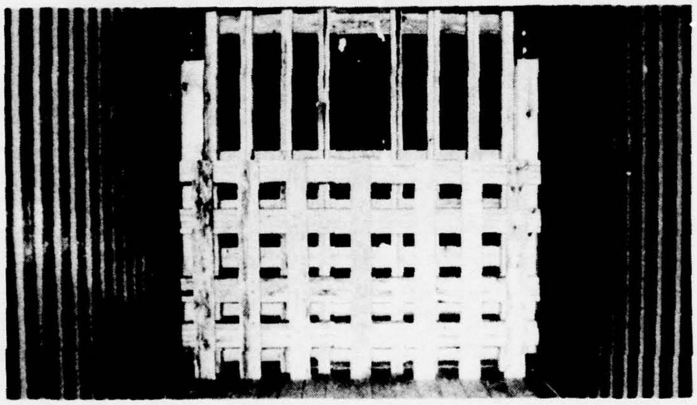


Figure 26 - Adapter Installed Between Front Bulkhead and Front Wall Panel In All-Steel Container

2. Trailer on Flatcar (TOFC)

The same inspection procedure was followed as described in Section IV, Paragraph A. The lading shift, where measured by the displacement gages, was in agreement with observed displacements during impact testing (COFC) at NWHC. The following summarizes the observations for each test configuration (Table IV).

The Aluminum Exterior Container, CTI 068878, remained tight and secure throughout. A crack was noted in the top board of the rear bulkhead after the 8 MPH "A" end impact. The crack was approximately 10 inches long and located in the center area of the board (Figure 27). The crack did not propagate further throughout the subsequent testing or return transit to NWHC. After examination this bulkhead was judged to be reuseable with minimal repair.

After the 8 MPH "B" end impact, deflection of the front bulkhead was evident, but not sufficient to contact the front wall. Due to limited accessibility, it was not possible to examine this bulkhead further. After subsequent testing and shipment to NWHC, the container was unstuffed and examined. No damage was evident and the front bulkhead was judged to be reusable as is.

Figure 27 - Crack In Top Board Of
Rear Bulkhead

The FRP Container, SN 49834, the 105MM ordnance and restraint system stood tight and secure throughout the rail impacts. The sole notable occurrence was an instance of the jam nuts "unjamming." This was also noted in the other configurations during other tests. Unthreading of the nuts on the rods was not evident. The nuts remained in the same relative position on the rods with 1/2 turn or less separating the jam nut from the principle nut. No retightening of the nuts was attempted. In some instances the nuts were retightened during subsequent testing.

The All-Steel Container, CTI 251425, the TOFC impacts were conducted on this test configuration after the hazard and rough road tests were completed.

The impacts against the "A" end (4, 6 and 8 MPH) were performed without discernible damage. The impact toward the "B" end in excess of 8 MPH produced the same type of bowing in the front wall panel as occurred in the corresponding COFC test. The maximum deflection was approximately 1/2 inch in the area corresponding to the second tier of bombs. In order to determine whether this was permanent deformation, an additional impact was made against the "A" end. The velocity was not measured but was sufficient to remove the slack in the cables and shift the load off of the front wall. The deformation which remained in the wall panel after this impact was considerably less than 1/2 inch, indicating that a major part of the initial deflection was temporary. Figure 28 was taken after this additional impact and is included for reference although little is apparent due to the dimensions involved.

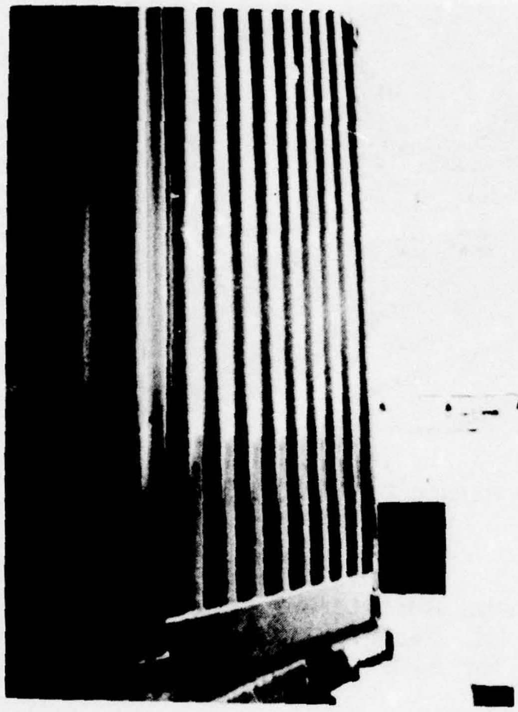


Figure 28 - Front Wall of Steel Container After Additional Impact Toward "A" End

C. Road Tests

All three configurations were subjected to testing as described in Section III, Paragraph C. The MK 82 configuration underwent Parts 1, 2 and 3 prior to the TOFC test and Part 4 after the TOFC. The 105MM and 155MM configurations underwent the road tests in sequential order. The following is a summary of the results for each configuration:

1. Aluminum container with 155MM: No evidence of change.

2. FRP Container with 105MM: No evidence of change.

3. Steel Container with MK 82 Bombs: No evidence of change. During the first traverse of the hazard course the right side structural angle lifted slightly and hung up on the side rail approximately 1 inch above the floor (Figure 29). This was not corrected. It was anticipated that further road testing would cause this angle to assume its original position. However, it did not. In addition, after the second hazard course traverse, the left side structural angle hung up on its side rail ledge. This configuration completed the road tests without further incident and then underwent the TOFC impact tests with both angles in this position. Following the rail impacts tests previously described, this configuration completed the washboard road test satisfactorily.

Approval for future shipments of all three ordnance types has been granted by the AAR (BUEX) based upon the results of the rail and road testing.

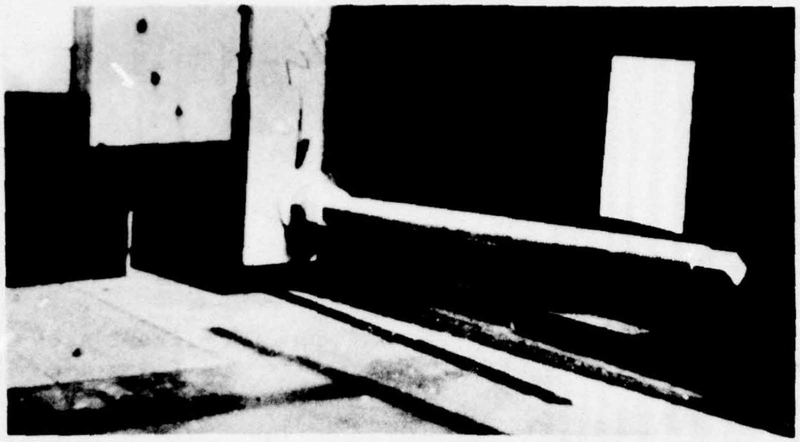


Figure 29 - Structural Angle (Right) Lifted During Hazard Course Test

D. 80° Tilt Testing

The three test configurations were tested in accordance with the procedure described in Section III, Paragraph D. The following is a summary of the test observations for each configuration in the order of testing:

FRP Container with 105MM Ordnance. The container completed the full tilt 0° to 80° to 0°, holding for 5 minutes at 80° (Figure 30). No change was evident. However, at the start of this tilt, there was slack evident in all cables. Although the cables had been taut when shipped from NWHC, the subsequent shipment and testing probably compressed the dunnage somewhat as well as aligned the ordnance boxes, causing the cables to slacken. The U.S. Coast Guard representative requested an additional tilt test with tensioned cables to determine the effect on sidewall deflection. The four tie rod nuts were tensioned an average of 1/2 inch. The range was from 3/8 to 9/16 inches. The tilt test procedure was then repeated. The deflection measurements were in agreement with the first test. There was no evident change to the 105MM ordnance, the restraint system, or the container.

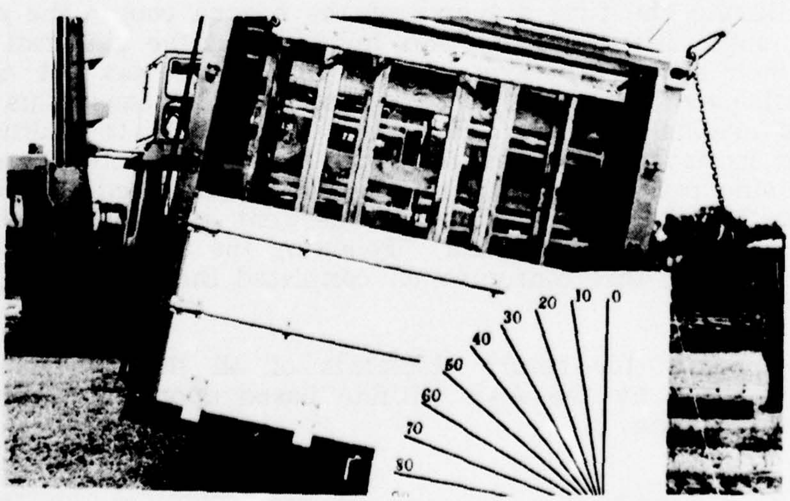


Figure 30 - FRP Container With 105MM Ordnance Holding At 80°

All Steel Container with MK 82 Bombs. This configuration had been designated for testing without any side bracing as explained in Section II, Paragraph B. As the tilt angle was increasing from 0°, deflection was apparent from the beginning and increased to 30°. At 40°, creasing of the sidewall began due to contact with the horizontal corners of the top tier unit loads. The tilt was continued slowly to 80°, no deflection measurements were taken. The creasing and overall deformation was pronounced (Figures 31 and 32). Shortly before achieving 80°, the center dunnage spacers collapsed permitting the right side unit loads to drop onto the left. The container was returned to the upright position and no further damage such as broken welds or wall punctures was noted (Figure 33). It was agreed that the container wall had failed, not the restraint system.

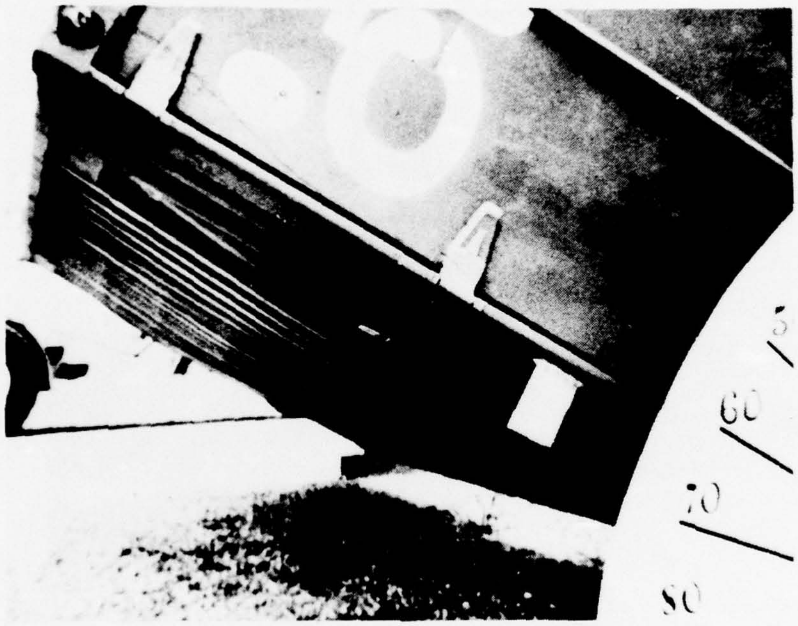


Figure 31 - Steel Container At 60° Angle During Tilt Test

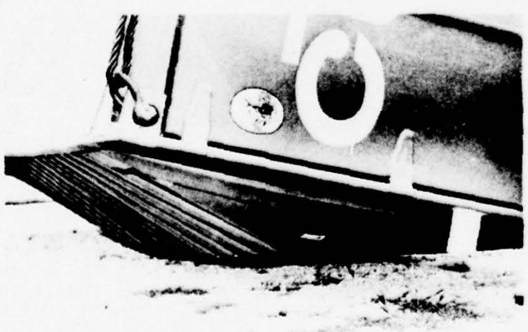


Figure 32 - Steel Container At 80° Angle During Tilt Test

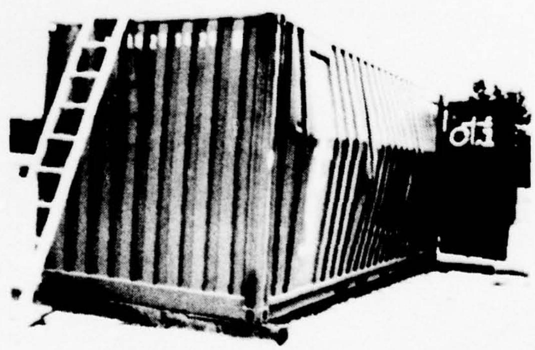


Figure 33 - Steel Container Upright After Tilt Test

Aluminum Exterior Container with 155MM Projectiles. (Figure 34) The same test procedure as previously described was followed. No evidence of change or damage to the test load or restraint system. The only notable damage to the container was another incident of rivet failure as discussed in Section IV, Paragraph B.

Based upon the results of these tilt tests, the U.S. Coast Guard has granted approval for future containership shipments of 105MM and 155MM ordnance when loaded and restrained as tested.

The MK 82 Bomb load subsequently received U.S. Coast Guard approval for containership shipments in conformance with drawings depicting suitable sidewall bracing. However, 80° tilt testing of the revised configuration was not required.

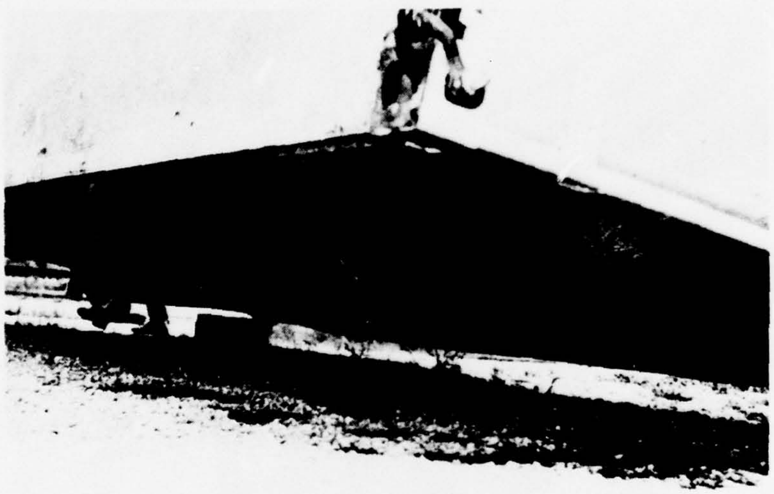


Figure 34 - Aluminum Panel Container During 5-Minute Hold At 80° Angle

V. CONTAINER STRUCTURAL TESTING AND EVALUATION

A. General

The purpose of this program was to determine the effect of the installation of IRSKIT on the structural characteristics of an ISO Container. The testing was extended to determine whether restoration of the corner posts to which IRSKIT is attached was required or could be economically completed after removal of IRSKIT.

A commercial container certification activity formulated a test procedure, conducted the testing and analyzed the results.

An all-steel container (CTI S/N 251328 - Table II) was selected to undergo the tests. This container is considered to be representative of a relatively inexpensive model which is in current production and in widespread use.

All IRSKIT components were transferred from another all-steel container (CTI 251425) which had been damaged during the 80° tilt test at AMC SAVANNA. Both main bulkheads and the front wall adapter from the AMC SAVANNA tests were utilized as well as the side wall bracing, which is now required.

In order to achieve the ANSI/ISO overload requirements, the inert ordnance was replaced by contractor furnished cast concrete weights (Figure 35).

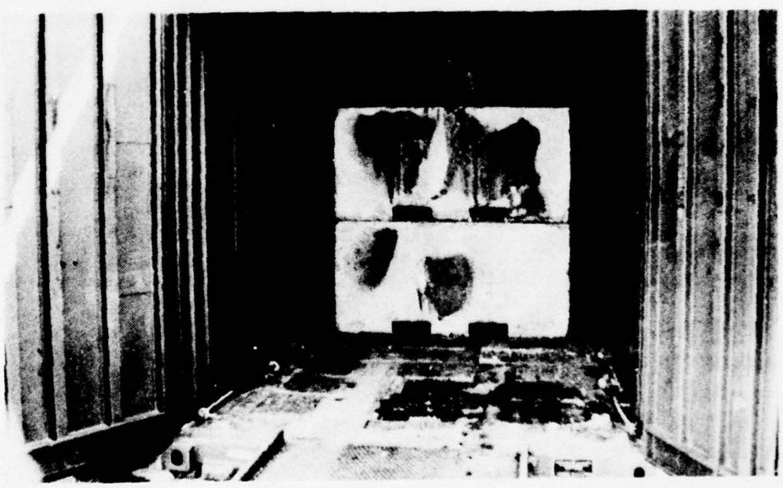


Figure 35 - All-Steel Container Partially Stuffed With Concrete Weights (Restraint Assemblies Visible On Floor)

B. Procedures

The tests were performed in accordance with ANSI/ISO requirements for certification of commercial containers. The procedures are described for the various testing modes.

Racking Tests. Racking forces, either longitudinal or transverse were introduced into the corner post by means of a hydraulic cylinder attached to an upper corner fitting. A predetermined hydraulic pressure was maintained for 5 minutes after which the appropriate diagonal measurements were taken (Figures 36 through 39).

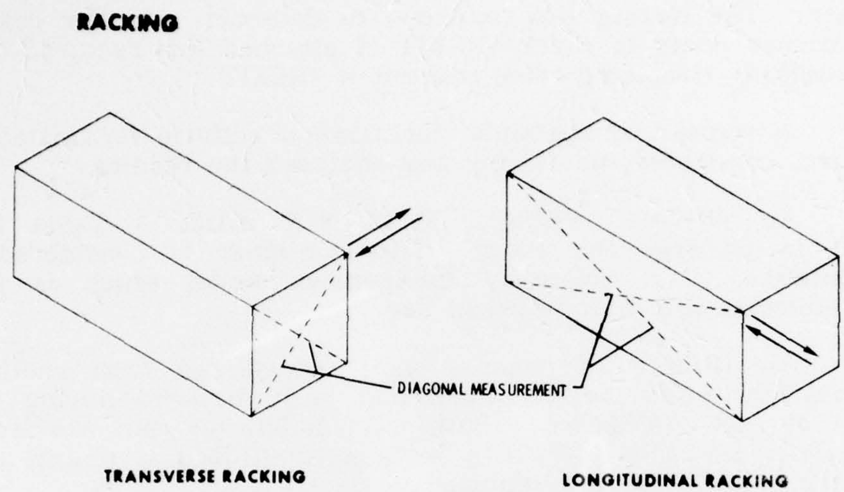


Figure 36 - Racking Tests (Schematic)

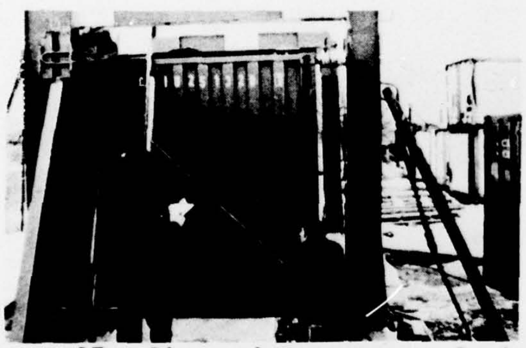


Figure 37 - Diagonal Measurement During Racking Test - Hydraulic Cylinder Pushing Against Upper Right Corner Fitting Producing Transverse Racking To The Left

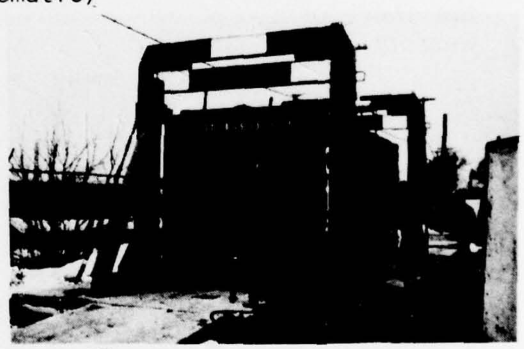


Figure 38 - Transverse Racking - Hydraulic Cylinder Outboard Of Test Frame Pulling Against An Upper Corner Fitting

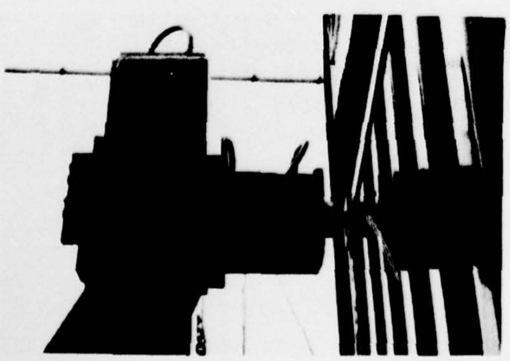


Figure 39 - Longitudinal Racking - Hydraulic Cylinder Inside Test Frame Pulling Against An Upper Corner Fitting

Stacking Tests. By means of two hydraulic cylinders mounted atop the container front corner fittings, vertical compressive loads were introduced onto the corner posts. The compressive loads simulate the equivalent of eight fully loaded containers supported by the bottom-most (ninth) container. [Hence the terminology "nine-high rated."]

ANSI/ISO test procedures specify that the stacking strength of the container corner posts shall be determined with the applied compressive forces located both concentrically and eccentrically relative to the center of the corner fitting. This is shown schematically in Figure 40. The actual test set-ups are depicted in Figures 41 through 44.

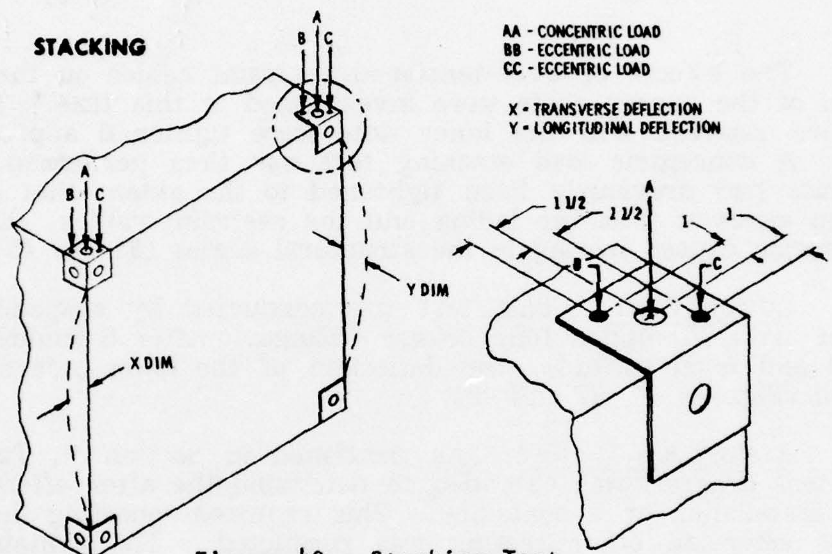


Figure 40 - Stacking Test (Schematic)

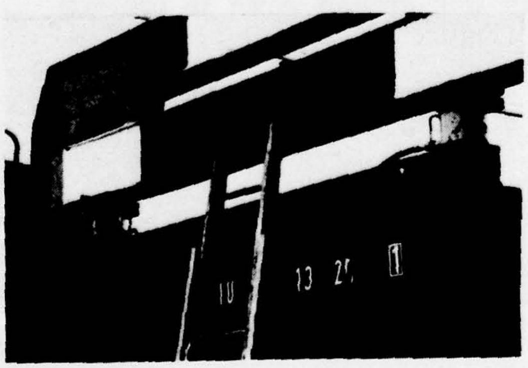


Figure 41 - Concentric Stacking Test Both Hydraulic Cylinders Applying Compressive Load Through Corner Fitting/ Floor Crossmember Assembly

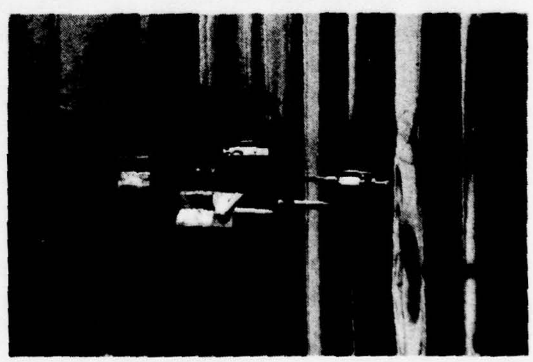


Figure 42 - Dial Indicators Used For Measuring Corner Post Deflection In Two Planes During Stacking Tests

Figure 43 - Eccentric Stacking Test (B-B)

Figure 44 - Eccentric Stacking Test (C-C)

The effects of over-tensioned restraint cables on the column strength of the corner posts were investigated at this time. The lock nuts were removed and the inner nuts were tightened approximately 1 inch. A concentric load stacking test was then performed. Since these nuts had previously been tightened to the extent that all slack had been removed from the lading and the restraint cables, this additional tension caused bowing in the structural angles (Figure 45).

Lifting Tests. This test was conducted by suspending the container from its upper four corner fittings. After 5 minutes in an elevated and level attitude, the deflection of the lower side rails was measured (Figures 46, 47 and 48).

Restoration Testing. As mentioned in Section V, Paragraph A, the test program was extended to determine the after effects of an IRSKIT installation on a container. This required repeating the stacking test after all other testing was completed. The container was emptied of all contents and all IRSKIT components were removed. The holes in the right corner post remained open and unrestored. The holes in the left corner post were filled by plug welding with high tensile weld rod material. This build-up was ground down to conform to the original contour and then painted (Figure 49).

The container was restuffed with the same concrete blocks and dunnage as previously used. The stacking tests, both concentric and eccentric were then repeated.

C. Summary

The data recorded during this structural testing and the contractor's report are included as Appendix IV.

Figure 45 - Vertical Deflection Evident In Aluminum Structural Angle During Stacking Tests With Over-Tensioned Restraint Cable Assemblies

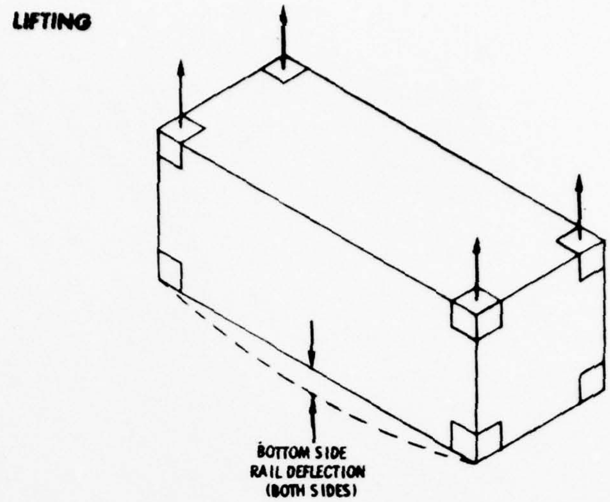


Figure 46 - Lifting Test Schematic

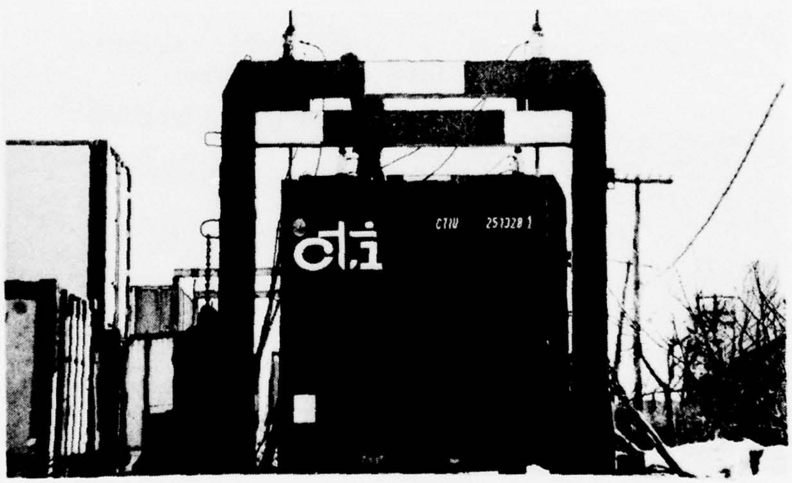


Figure 47 - Lifting Test - Two Hydraulic Cylinders At Each Test Frame Attached To Upper Corner Fittings

The results of the testing verify that the structural characteristics of the container, either with IRSKIT installed or after its removal, conforms to ANSI/ISO requirements. This is based on comparison with test results obtained by the test contractor with new containers of the same type. Little variation is evident from the different modes of stacking tests (i.e., normal tension vs over-tension on the restraint cables, or the plug welded vs as-modified open hole corner post).

Additionally, the data suggests further investigation into the necessity or method of restoration of the front corner posts after removal of the IRSKIT attachments. Reduction of these restoration costs has a significant bearing on the life cycle cost of IRSKIT. Heretofore, charges for complete replacement of the drilled corner posts have been incurred by NWHC upon return of the containers to the leasors. It now appears that replacement corner posts offer little or no structural advantage over either the as-modified or the plug welded posts.

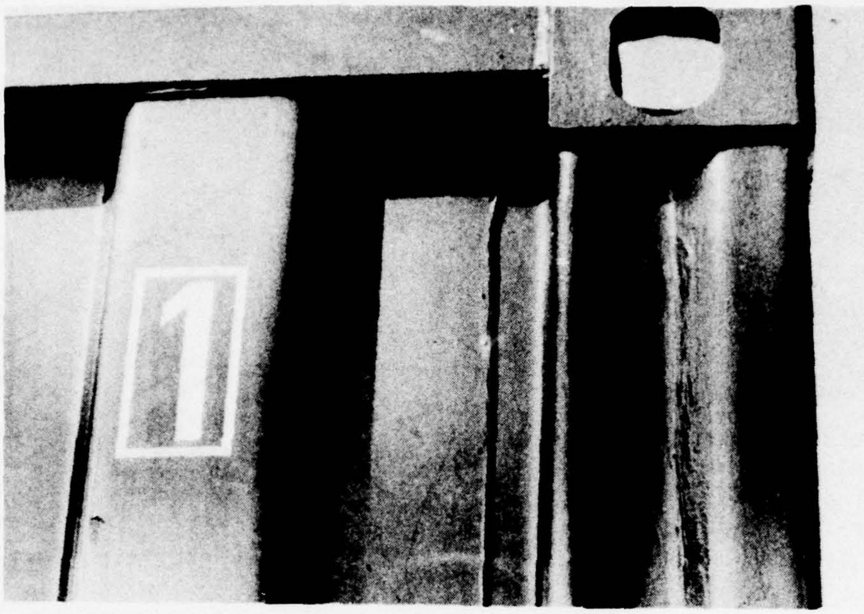


Figure 48 - Exterior: Right Corner Post-Plug Welded and Contoured

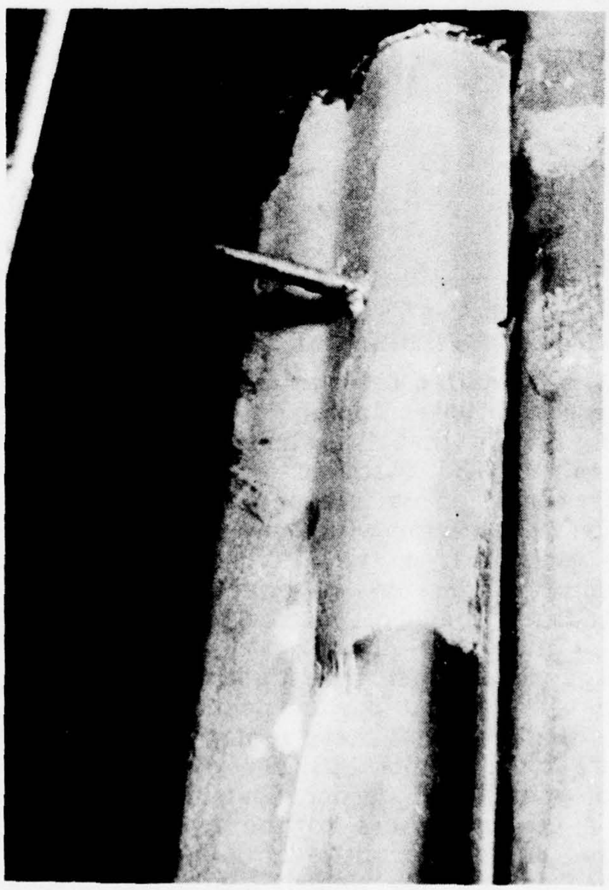


Figure 49 - Interior: Right Corner Post-Plug Welded and Contoured

VI. TRIAL SHIPMENT

A. General

After approvals for the IRSKIT system had been obtained from both the BUEX and the U.S. Coast Guard (Division of Hazardous Materials), an operational evaluation was requested by the Program Manager for Army Container Oriented Distribution System (ACODS-PM). This exercise required the coordinated efforts of various DOD activities and commands. The bulk of this exercise consisting of container loading and the overseas shipment was scheduled for August and September 1978.

A plan of operations was prepared by U.S. Army DARCOM Ammunition Center, Savanna, IL. The following is an exerpt from this OPLAN:

> August 1978 Test Shipment OPLAN
>
> 1. SCOPE/PURPOSE:
>
> This operation plan addresses the requirements to support a test shipment program involving the movement of containerized ammunition to Europe. This test shipment is scheduled to move with the August 78 shipment by eighteen (18) commercial 20-foot intermodal freight containers on the ship AMERICAN RANGER. The ammunition is to be blocked and braced within the containers by use of the Navy-developed Internal Restraint System Kit (IRSKIT) and various wooden dunnage components that are necessary to support the IRSKIT system. Loading of containers and application of the IRSKIT system is to be accomplished in accordance with approved DARCOM outloading drawings applicable to the ammunition to be shippped.

This OPLAN further identified those areas of NWHC responsibility as the following:

1. To provide one complete set of IRSKIT components (including instructions for installation) for each of the containers in the trial shipment.

2. To provide technical assistance during the IRSKIT installation and container stuffing operations.

3. To provide suitable instruction for removal from the containers and return packaging of IRSKIT from the destination of the trial shipment.

B. Hardware

New parts and components for the IRSKIT Systems were procured by NWHC from approved suppliers. These parts and components conformed to the same drawings or specifications as the parts and components which had undergone the regulatory agency approval testing.

After inspection and selective testing for quality assurance purposes, the parts were grouped and packaged as a complete restraint system set or kit.

Figure 50 shows the wooden box fabricated for shipping. A set of installation instructions was also included. One box designated for each of the two destinations also included the extension wrench suggested for rapid nut installation. That box was so marked.

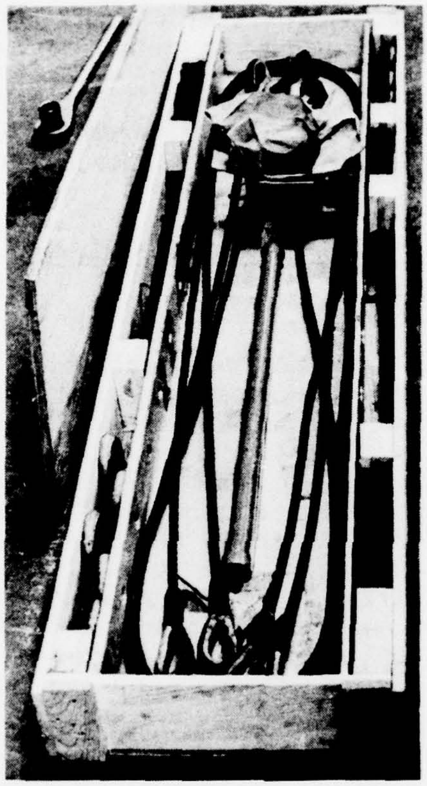


Figure 50 - Shipping Box Constructed For Transporting Individual IRSKITS From NWHC To Trial Shipment Originating Depots

C. Technical Assistance

During the week of 16 August 1978, an NWHC system engineer was assigned to both ANNISTON AD and MILAN AAP to provide guidance as required during the IRSKIT installation and container stuffing. NWHC representation was also provided subsequently at the outloading port, Military Ocean Terminal, Sunny Point, (MOTSU). The purpose was twofold. First to examine the trial shipment (restraint systems, lading, and containers) after the rail shipment from the originating depots. Secondly, to verify that with the external back-up plates (previously described in Section II, Paragraph B) installed on the containers, adequate clearance existed in the ship's cell guides.

D. Return Shipment

Instructions for IRSKIT removal and return shipment were transmitted by NWHC to the destination activities of the trial shipment containers.

The removal of IRSKIT from a container is essentially the reverse of the installation procedure. The return shipment instructions were contained on shipping condition drawings with detailed information on the construction of wooden boxes and the placement within of the IRSKIT parts and components.

These wooden boxes would be duplicates of those provided in the original shipment of the 18 separate IRSKITS from NWHC to the trial shipment originating activities. At the consignee's option, the IRSKIT components could be returned in suitable wooden crates in accordance with DOD approved procedures.

E. Outloading Summary

As listed in the OPLAN, certain DOD Commands or activities were tasked with submitting specific data to AARCOM, Rock Island, IL for inclusion in an after action report on this trial shipment. This data pertained to the cost or quantities of either material, labor, transportation or other requirements. Since the AARCOM after action report will contain the analysis and summary of costs and requirements, readers should refer to it for any information in those areas.

This section will address aspects of the trial shipment dealing with "nut and bolts" as observed by the NWHC technical representative. The shipping containers or wooden boxes did an excellent job of securing and protecting IRSKIT during the transit from NWHC to the loading depots. Both destinations were approximately 1,000 miles from NWHC, and the shipping mode was by truck. Neither the boxes nor their contents showed any signs of damage or deterioration during this transit to the ammunition depots.

Container preparation prior to IRSKIT installation required the installation of four pairs of holes in the front corner posts. This has previously been accomplished by drilling a pilot hole approximately 1/4 inch diameter, followed by the final diameter of 7/8 inches. An electromagnetic baseplate type portable drill press is required. This operation has been most effectively accomplished on containers with flat corner posts due to the maximum magnetic pull of the flat corner post and the flat drill baseplate. Corner posts with irregular cross sections present reduced contact area and consequently less magnetic pull and stability of the drill press. A slower drilling speed must be used in order to maintain accuracy. This is time consuming and requires more manpower. At one of the depots, the full size hole was installed with a cutting torch instead of drilling in order to expedite the hole installation on several containers of this type.

The time required was significantly less for burning holes than it would have been for drilling on these types of containers. This was permissible only when a specified safe distance was maintained from the ammunition.

Two of the 18 containers provided for the trial shipment were not compatible with the back-up plates supplied with IRSKIT. Both containers were of all steel construction, each having different types of irregular cross section corner posts. The cross sections were such that neither side of the plates (flat or chamfered) could be mounted on the corner posts properly.

A simple modification was made to the plates for use on both of these containers. Material was machined from the width to allow the plates to fit into the corner post recesses. This was accomplished at that activity's machine shop. The amount of material removed was 1/8 inch from one side and 5/8 inches from the other side (Figures 51 and 52). Figures 53 and 54 show these modified plates after their installation on the containers.

Figure 51 - Backside View Of Modified Back-up Plate (Right) versus As-Supplied Plate (Left)

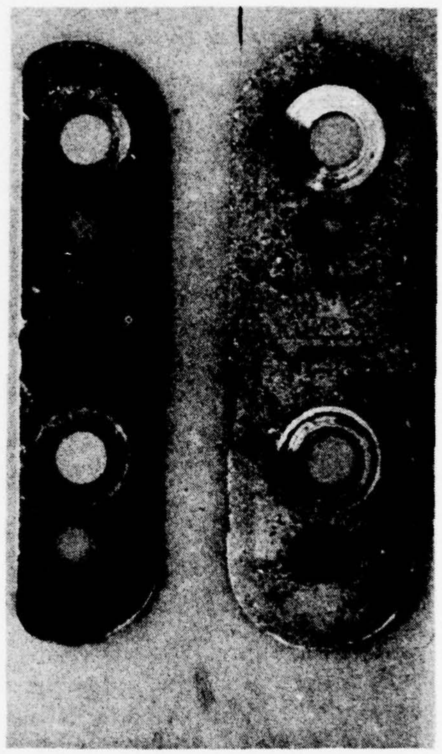


Figure 52 - Frontside View Of Modified Back-up Plate (Left) versus As-Supplied Plate (Right)

This modification to the two sets of as-supplied plates enabled the trial shipment to proceed in its entirety as planned. Any alternative action such as rejecting the two containers would have meant either a smaller trial shipment, or a delay while two other containers were obtained.

All 18 containers were transported by rail in the container on flatcar mode (COFC) to the outloading port (MOTSU) where they were transferred to container chassis by means of an overhead crane.

The trial shipment was then moved to a holding area. While in the holding area, the containers were subjected to an examination by cognizant personnel. No deterioration or damage to the lading (ammunition), dunnage, containers or restraint systems was evident. The containers were subsequently moved to the wharf area where a gantry crane removed the containers from the chassis and loaded them onto the containership. Sixteen of the containers were loaded into container cells and two remained above decks lashed down on hatch covers.

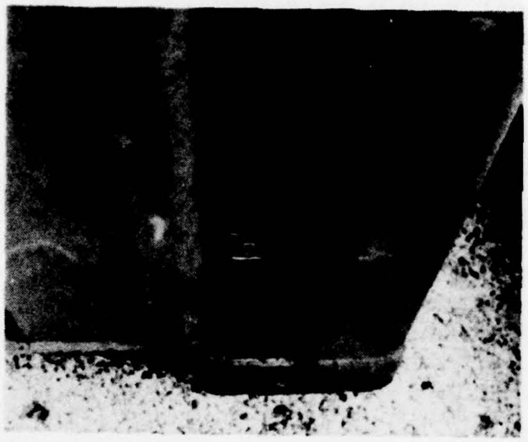


Figure 53 - Modified Back-Up Plate As Installed In One Type of Corner Post

Figure 54 - Modified Back-Up Plate As Installed In A Second Type of Corner Post Recess

There were 11 containers (10 FRP, one all-steel) with flat corner posts in this trial shipment. The flat corner post represents the "worst case" in terms of container-to-cell guide clearance. This is due to the addition of the full thickness (1/2") of the back-up plate to the overall length of the container. The "best case" is found on containers with irregular corner posts, since the plates will be fitted into the recess (although still external to the container); thereby causing no change to the container length.

During the loading of the trial shipment containers into the containership cells, no instances of interference or binding occurred. Actual clearance could not be measured directly when the containers were in the cell guides; however, observation showed that this clearance was always more than 1 inch.

F. Trial Shipment Addendum

1. Corner Post Compatibility

A high probability of compatibility of IRSKIT with different types of containers and lading was included as a design goal (Section II, Paragraph B) at the inception of the development effort. Primarily, this requires conformity between the mating surfaces of the back-up plates and the containers front corner post (exterior). The cross-section selected for the back-up plates has been described and shown.

Following the trial shipment where the incompatibility was first encountered with two of the containers (requiring the back-up plate modification), it was deemed appropriate to conduct a survey of commercial container corner post types.

To date, more than 1,000 containers have been examined by NWHC personnel with a backup plate compatibility of 98%. These examinations took place at (1) a major container leasor's repair and storage facility and (2) a container port where containers owned by either shipping lines or leasors are handled.

2. Returned Component Inspection

The IRSKIT components used in the trial shipment were returned to NWHC in February 1979. Following an examination and inspection, all components were found to be suitable for reuse.

VII. TIME STUDIES

A. General

Typical time and manpower requirements for specific IRSKIT operations are available from time studies conducted and described herein.

The first of these was the time study conducted at NWHC using the same restraint systems, containers and inert ordnance as used for the regulatory approval testing. The second time study was conducted during and as part of the overseas trial shipment of live ordnance.

B. NWHC Time Study (Nov 1977)

1. Preparation, Procedures and Equipment

As stated above, the NWHC time study was conducted on the same configurations which had been subjected to regulatory testing at AMC SAVANNA. All were returned to NWHC by truck. The 105MM and 155MM configurations were transported in the same condition they were in at the completion of testing. The MK 82 container required repair in order to straighten the wall panel deformed during the 80° tilt test and replace the collapsed center aisle dunnage.

All three containers arrived at NWHC with no apparent damage or deterioration attributable to shipment. The contents of all containers were examined, including each component of the restraint systems and each item of dunnage.

Since sidewall bracing would hereafter be required for shipments in steel containers, this was designed, fabricated and used for the time study of the MK 82 bomb load stuffing. Another steel container identical to the damaged steel container was substituted at NWHC for the time study.

All time studies were conducted under conditions considered representative of a container loading area. The personnel were not experienced ordnance loaders, but were Test and Evaluation technicians qualified to operate forklift equipment. Both forklift trucks used were electric powered 4,000-pound capacity, with side shifting tines.

The forklift trucks traveled approximately 100 feet between the test load marshaling area and the container during stuffing and unstuffing operations. Due to the long length of thread on the restraint rod, several means for installing or removing the nuts were devised. The first was an open socket and ratchet arrangement for manual installation. The second was an extension tube and socket for use with an electric impact wrench. These are shown in Figures 55 through 58. The second method was used during the time study. A hex head key was attached to the impact wrench for final threading and tightening of the cap screws after the screws had been started with a hand tool (Figures 59 and 60).

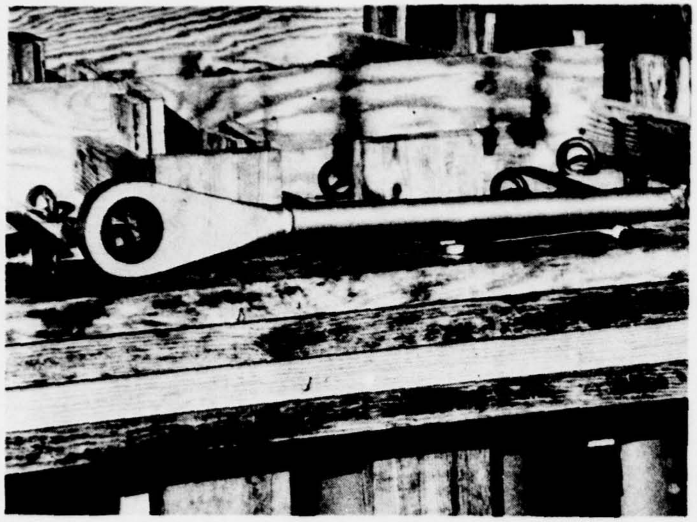


Figure 55 - Reversible Ratchet Box Wrench and 1-1/2" Socket Wrench Adapter Shown Separated

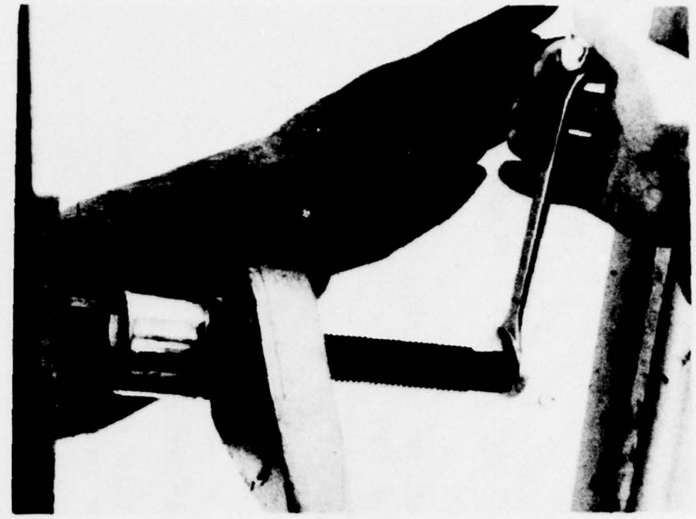


Figure 56 - Reversible Ratchet Box Wrench and 1-1/2" Socket Shown Tightening The Rod Jam Nut (Open End Wrench On Wrench Flat To Prevent The Rod Turning)

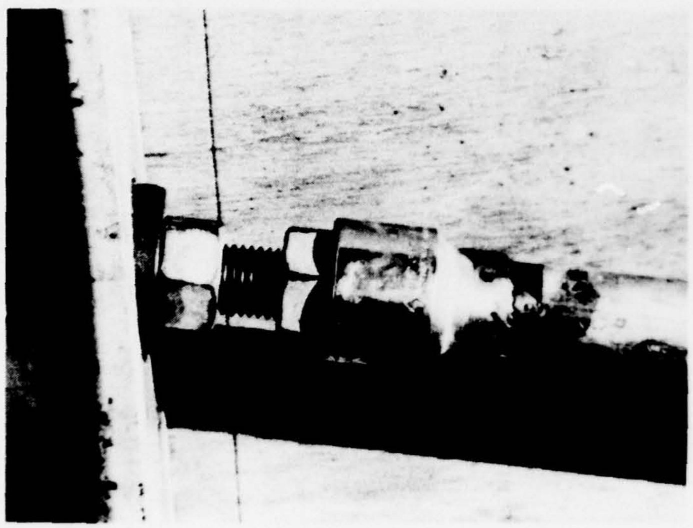


Figure 57 - Close Up View of 1-1/2" Socket and Portion Of The Extension (Also Shown Is The Spherical Washer Recessed Into Angles Spotface)

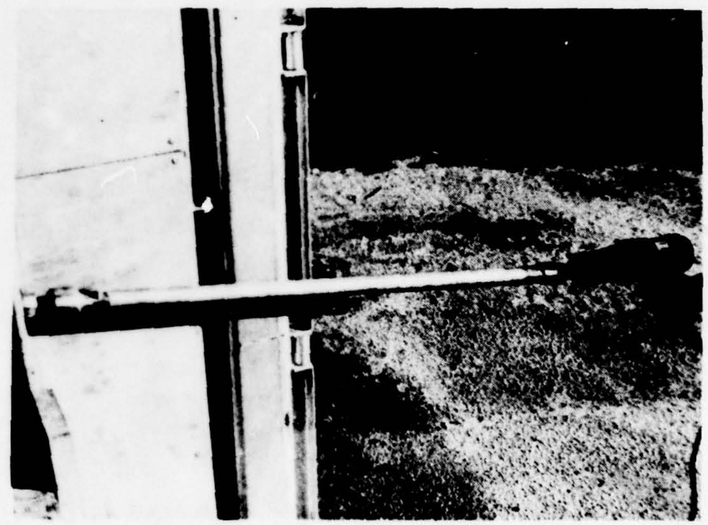


Figure 58 - 1-1/2" Socket, 36" Extension and Impact Wrench During Jam Nut Installation On 155MM Projectile Load

A side lift attachment was fabricated for the fork truck tines in order to handle long or heavy sections of sidewall bracing. This attachment enabled the forklift operator to place the bracing in its exact final location with little need for manual handling of the bracing (Figure 61). This was most helpful with the 105MM and MK 82 bracing, and less so with the lighter 155MM bracing.

Finally, a stop or guard was fabricated for the forklift tines when loading 155MM unit loads. This was approximately the same depth of a unit load bottom skid. The fork tines were long enough to accept three unit loads when that was the required grouping. When the grouping was for two unit loads, the stop was placed on the tines to prevent puncturing and catching on the plywood separators (Figure 62). The results of the time study are included as Table V.

C. Trial Shipment Time Study

Detailed time study data was recorded at each loading activity for inclusion in the AARCOM after action report. This section will deal with information extracted from the study conducted during the loading of seven F.R.P. and five steel containers with 105MM ordnance.

Table VI summarizes the actual results for the separate operations as categorized by the time study personnel. In a subsequent section of that report an estimate is given of what could be attained on a regular basis. Also noted in the study is the fact that current MILVAN shipments require approximately 12 to 14 hours per MILVAN.

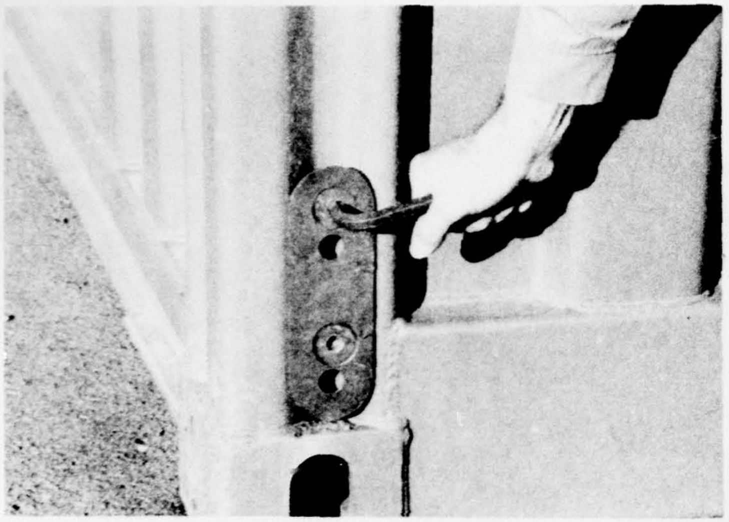


Figure 59 - Hex Head Key Used To Start Cap Screw Installation

Figure 60 - Impact Wrench With Hex Head Key Bit Used For Final Installation Of Cap Screws

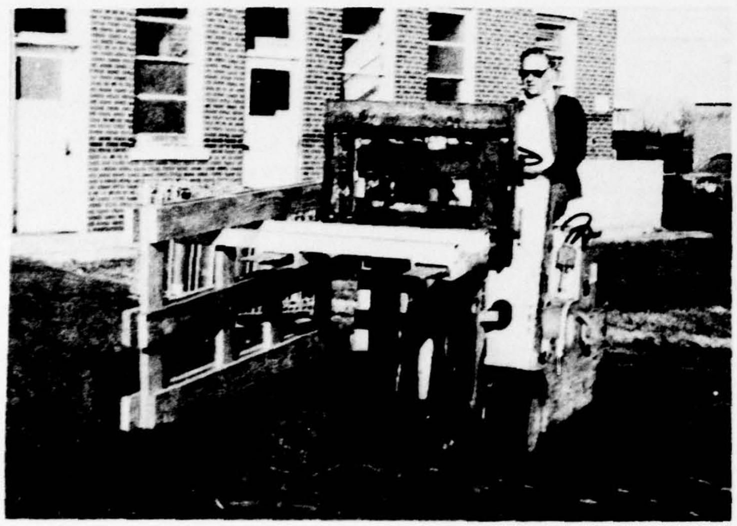


Figure 61 - Sidelift Adapter On Fork Tines For Transport And Placement Of Side Bracing

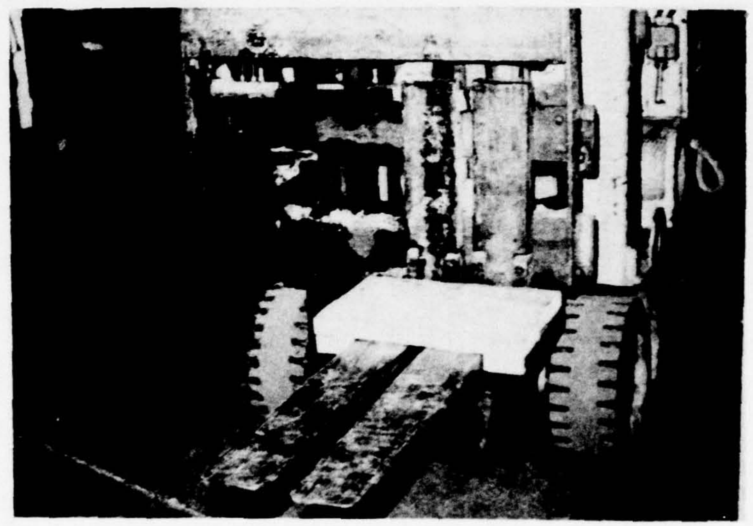


Figure 62 - Fork Tine "Stop" For Use When Stuffing 155MM Projectile Unit Loads

NWHC TIME STUDY SUMMARY

INERT LOAD (REFER TO TABLE II)

OPERATION	105 MM			155 MM			MK 82 BOMBS		
	M/H	MEN	ELAPS TIME	M/H	MEN	ELAPSED TIME (HRS)	M/H	MEN	ELAPSED TIME (HRS)
1. Container Modification	1.0	2	0.5	1.0	2	0.50	1.0	2	0.50
2. IRSKIT Installation	1.0	2	0.5	1.0	2	0.5	1.0	2	0.50
3. Dunnage Fabrication:									
Expendable (1)	1.0	2	0.50	6.4	2	3.2	5.0	2	2.5
Reusable (2)	6.0	2	3.0	3.0	2	1.5	9.0	2	4.5
TOTAL	7.0		3.50	9.4		4.7	14.0		7.0
4. Stuffing	2.25	3	0.75	2.4	3	0.80	2.10	3	0.70
5. Unstuffing	1.2	3	0.4	1.41	3	0.47	1.41	3	0.47

(1) Sidewall bracing and intermediate assemblies.

(2) All forward and rear bulkheads and filler/adapters.

TABLE V

TABLE VI

(Trial Shipment Study Summary)

Activity	Crew Size	Actual Hours	Total MH	MH/ Container	Estimated MH/Container (See Text)
1. Unload and store IRSKIT assemblies	2	.3350	.67	.0558	.056
2. Unload and store empty containers	2	6.5050	13.01	1.0842	.750
3. Inspect containers	2	3.2550	6.51	.5425	
4. Prefab dunnage	3	34.3667	103.10	8.5917	9.000
5. Drill holes and install IRSKIT	5/7	16.5010	97.09	8.0908	3.637
6. Material handling from storage to shipping point	3	14.0000	42.00	3.5000	2.446
7. Stuffing of container	6	15.7483	94.49	7.8742	3.261
8. Install of container	4	7.4550	29.82	2.4850	.873
9. Loadout on flatcar	2	6.7550	13.51	1.1258	.714
	TOTALS		400.20	33.3500	20.737

VIII. CONCLUSIONS

A. The IRSKIT system as described herein has satisfactorily completed railcar impact tests in accordance with MIL-STD-1325, and over the road testing. These tests were conducted in order to obtain approval by the Bureau of Explosives (BUEX) of the Association of American Railroads (AAR). That agency has granted approval of future shipments of hazardous cargo restrained in commercial containers configured as described herein.

B. Additionally, the IRSKIT system has demonstrated the capability to provide satisfactory restraint during 80° tilt testing as required by the U.S. Coast Guard Division of Hazardous Materials. That agency has also granted approval for future containership shipments of hazardous materials using this restraint system configured as described herein.

C. Stuffing and unstuffing operations are not materially impeded by the presence of IRSKIT as indicated by the time study results.

D. The reusability of the IRSKIT components has been demonstrated by:

1. The number of times the three prototype sets used for the approval testing were installed, removed or interchanged.

2. The reusable condition of the restraint systems returned from the overseas trial shipment.

E. Structural strength will not be reduced during or subsequent to the usage of IRSKIT in a commercial container.

M E M O R A N D U M

17 March 1976

From: J. BOYLE (8051)
To: IRSKIT File

Subj: Aluminum ISO Container Corner Fitting Pull Test; info on

Ref: (a) Work Request 4543001-00114

1. As requested by reference (a), a pull test was performed on the two forward corner fittings of an 8'x8'x20' aluminum container to determine if the fittings are structurally adequate to be used as a restraining point in an IRSKIT concept. A Strick container (the one used in the empty and half loaded COTS drop tests under the tensile tower) was placed on top of one end of the inverted fixture used for testing devices to secure intermodal containers to flatbed trucks. The "bayonet" fittings of the fixture engaged the openings in two bottom corner fittings on the door end of the container. Four bomb loads were placed in the forward end of the container and a bi-rail, weighted to approximately 9,000 lbs. gross, was placed over the extreme end of the fixture. Two sling assemblies, each with a turnbuckle and appropriate shackles, were used to conduct and the extreme corners of the fixture. One end of each sling assembly was shackled to an extreme end corner of the fixture, and other end was attached to an eye bolt inserted into the 7/8" diameter hole which had been drilled in each forward upper corner fitting of the container. Slack in the slings was removed by the turnbuckles. Hydraulic pumps were attached to the hydraulic ram fittings on each side of the test fixture. Each of the two pumps was fitted with 0 to 50,000 pounds dial range gage.

2. The two pumps were simultaneously actuated against the hydraulic rams to extend the moveable section of the fixture, thus putting tension on the slings and the upper corner fixtures of the container. When each of the two gages read 20,000 pounds, this loading was maintained for a 5 minute period. The corner fittings did not deform, the only evidence of deformation was a slight bending in the two upper longitudinal frame members of the container. This was not a permanent deformation since the members returned to normal when the tension load was released.

J. BOYLE

NOTES:

1. THIS DRAWING PROVIDES DETAILED INSTRUCTIONS FOR LOADING FLEET ISSUE UNIT LOADS OF 500 LB. MK 82 THERMALLY PROTECTED GENERAL PURPOSE BOMBS IN 20 FT COMMERCIAL CONTAINERS. DETAILS OF THE UNIT LOAD ARE ON SHEET 1 OF THIS DRAWING. THE BOMBS SHALL BE PALLETIZED IN ACCORDANCE WITH WR-54/29.
2. THE LOAD IS BASED ON A 20' LONG BY 8' WIDE BY 8' OR 8'-6" HIGH CONTAINER. CONTAINERS HEAVIER THAN 5670 LBS. CAN NOT BE USED BECAUSE THE RESULTANT GROSS WEIGHT WOULD EXCEED THE PERMITTED MAXIMUM OF 44,800 LBS.
3. THE INTERNAL RESTRAINT SYSTEM KIT (IRSKIT) SHALL BE INSTALLED IN ACCORDANCE WITH NWHC DRAWING NO. 7712. CABLES SHALL BE TENSIONED SUFFICIENTLY TO REMOVE ALL SLACK. JAM NUTS SHALL BE IN PLACE AND TIGHTENED.
4. WHEN THE LOADED CONTAINER IS IN TOFC/COFC SERVICE, ONLY FLAT RAILCARS THAT COMPLY WITH BUREAU OF EXPLOSIVES PAMPHLET 6C SHALL BE USED.
5. THE LOADED CONTAINER SHALL BE ON A 20 FT MILVAN CHASSIS EQUIPPED WITH DOUBLE BOGIES WHEN BEING MOVED IN TOFC SERVICE.
6. THE LOADED CONTAINER MAY BE TRANSPORTED OVER PUBLIC HIGHWAYS ON A PROPER CHASSIS/MODIFIED FLATBED TRAILER THAT ENSURES COMPLIANCE WITH THE WEIGHT LAWS OF THE STATE OR STATES THROUGH WHICH THE VEHICLE IS ROUTED.
7. SUFFICIENT SHIMS, PIECE 27, OF APPROPRIATE THICKNESS SHALL BE USED TO FILL THE VOID BETWEEN PIECE 3 OF DETAIL B AND CONTAINER CORNER POST. WITH SHIMS (LAMINATED) AND DETAIL B IN PLACE, NAIL BUFFER, PIECE 3 OF DETAIL B, TO SHIMS, PIECE 27.

NOTE

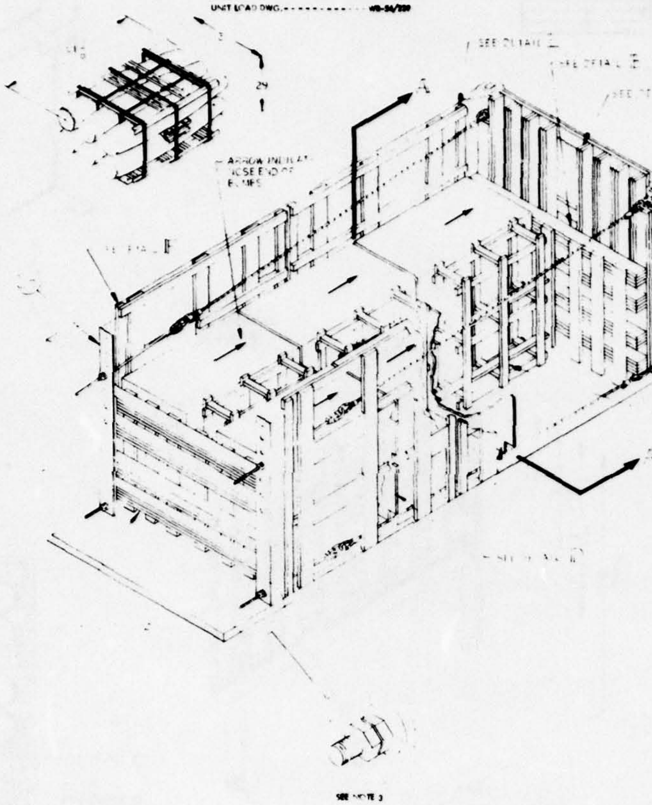
WHEN PROPERLY INSTALLED, DETAIL C BEARS AGAINST THE FRONT WALL OF THE CONTAINER WITH DETAIL B BEARING AGAINST IT. THE VOID BETWEEN PIECE 3 OF DETAIL B (2 PLACES) AND CONTAINER CORNER POSTS IS FILLED WITH JUST THE RIGHT THICKNESS OF SHIMS, PIECE 27 TO PERMIT THE CONTACT OF ALL ITEMS INVOLVED.

8. APPLICABLE MATERIAL SPECIFICATIONS: DUNNAGE LUMBER, MM-L-751; NAILS, FF-N-105, TYPE II STYLE 10, COMMON BRITE.
9. AFTER BLOCKING AND BRACING HAS BEEN INSPECTED, ATTACH SHIPPING DOCUMENTS INSIDE THE CONTAINER IN AN ACCESIBLE AREA, CLOSE AND SEAL CONTAINER DOORS AND ATTACH "EXPLOSIVES A" PLACARD TO BOTH SIDES, FRONT AND REAR OF CONTAINER.

CONTAINER LOAD DATA

ITEM	QUANTITY	WEIGHT (APPROX)
UNIT LOAD OF BOMBS	12	37,068 LBS.
DUNNAGE (W/IRSKIT)	-	2056 LBS.
CONTAINER NET WEIGHT (MAX. ALLOWABLE)		5676 LBS.
MAXIMUM GROSS WEIGHT		44,800 LBS.

PALLETIZED UNIT
UNIT WEIGHT (APPROX) .... 3089 LBS.
CUBE .... 36.1 CU. FT.
UNIT LOAD DWG. WR-54/239



\# NOTE - RIP 2 X 6 TO OBTAIN 2 X 3
* CW = CONTAINER WIDTH (INSIDE)
** CH = CONTAINER HEIGHT (INSIDE)

PIECE NO.	DESCRIPTION	SIZE	NO. OF PIECES REQ'D	NAIL TO	NUMBER (NAILS)	SIZE (NAILS)
28	IRSKIT	NWHC 7712				
27	SHIM	6 WIDE X 72 THICKNESS TO SUIT	AS REQD	LAMINATE	AS REQD	AS REQD
26	SPACER	2 X 4 X 60	6	25	3/JOINT	10 d
25	STRUT	2 X 4 X TO SUIT	27	SEE NAIL TO 20	3/JOINT	12 d
24	HORIZONTAL	2 X 4 X 47	16	SEE 23		
23	VERTICAL	2 X 4 X 60	16	24	3/JOINT	10 d
22	BUFFER	2 X 6 X 46 3/4	2	20	3/JOINT	10 d
21	UPRIGHT	2 X 6 X 54 1/2	2	20	3/JOINT	10 d
20	HORIZONTAL BEAM ASSY.	2 X 6 X CW* -2 1/2	16	LAMINATE 4 PIECE	11/PIECE	10 d
19	FILLER	2 X 10 X 27	2	16 & 17	5	10 d
18	FILLER	2 X 10 X 9 3/4	2	16 & 17	3	10 d
17	HORIZONTAL	2 X 3 X 90 #	2	SEE 13 & 14		
16	HORIZONTAL	2 X 4 X 48 1/4	2	13 & 14	3/JOINT	10 d
15	HORIZONTAL	2 X 4 X 90	2	SEE 13 & 14		
14	VERTICAL	2 X 6 X CH** -1	6	15 & 17	3/JOINT	10 d
13	VERTICAL	2 X 4 X CH** -1	4	15 & 17	3/JOINT	10 d
12	FILLER	2 X 10 X 10	4	9 OR 10	3	10 d
11	FILLER	2 X 10 X 27 1/2	4	9 OR 10	5	10 d
10	HORIZONTAL	2 X 3 X 94 1/2 #	2	SEE 7 & 8		
9	HORIZONTAL	2 X 4 X 94 1/2	4	SEE 7 & 8		
8	VERTICAL	2 X 8 X CH** -1	6	9 & 10	3/JOINT	10 d
7	VERTICAL	2 X 4 X CH** -1	4	9 & 10	3/JOINT	10 d
6	PLYWOOD SEPARATOR	1/2 X 48 X CW* -5	2			
5	CROSSMEMBER	2 X 6 X 70 1/2	6	4	3/JOINT	10 d
4	VERTICAL BEAM ASSY.	2 X 6 X 92	16	LAMINATE 2 PIECES	11	10 d
3	BUFFER	2 X 6 X 72	2	1	3/JOINT	10 d
2	UPRIGHT	2 X 6 X 54 1/2	7	1	3/JOINT	10 d
1	HORIZONTAL BEAM ASSY.	2 X 6 X CW* -1	16	LAMINATE 4 PIECE	11/PIECE	10 d

LIST OF MATERIALS & NAILING DATA

ZONE	LTR	REVISIONS DESCRIPTION		DATE	APPROVED

CLASSIFICATION OF CHARACTERISTICS (WR 43)
CRITICAL
MAJOR
MINOR

NEXT ASSY | USED ON
APPLICATION

INTERPRET DRAWING IN ACCORDANCE WITH MIL-STD-100
DO NOT SCALE THIS DRAWING. DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
2 PLACE DECIMALS FRACTIONS
3 PLACE DECIMALS ANGLES
REMOVE BURRS, BREAK SHARP EDGES
SURFACE ROUGHNESS

APPROVED BY
BUREAU OF EXPLOSIVES | U.S. COAST GUARD
MILITARY ASSISTANT DATE | SIGNATURE DATE

NAVAL WEAPONS HANDLING CENTER
NWS EARLE
COLTS NECK, N.J. 07722

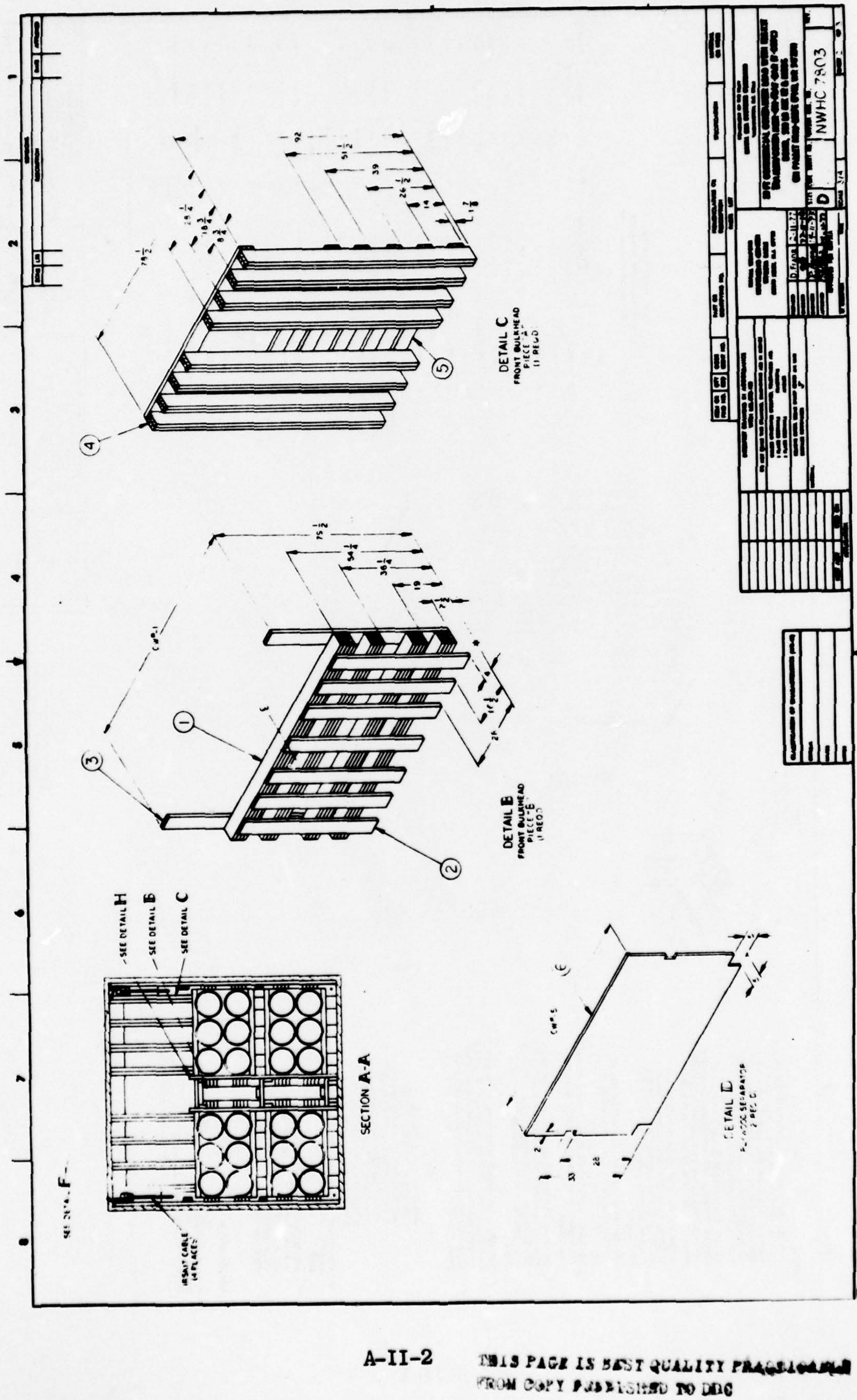
PREPARED
CHECKED 77-11-14
ENGINEER 77-11-77
APPROVED 11-77
BY DIRECTION DATE

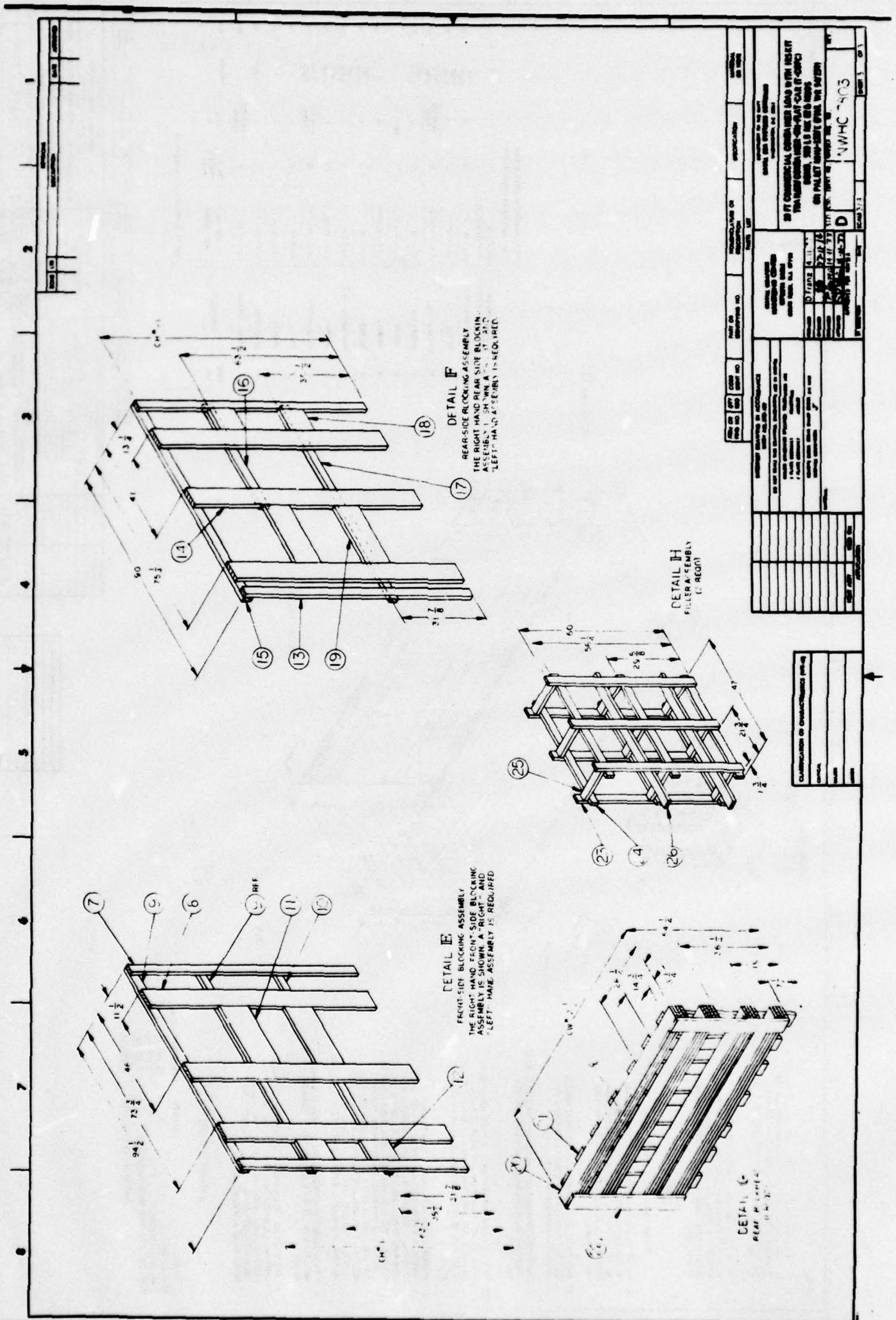
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C.

20 FT COMMERCIAL CONTAINER LOAD WITH IRSKIT
TRAILER/CONTAINER-ON-FLAT-CAR (T-COFC)
BOMB, 500 LB MK 82 & MODS
ON PALLET MHU-122/E (FIUL WR 54/239)

D

SCALE | SHEET OF


SECTION A-A
SEE DETAIL H
SEE DETAIL B
SEE DETAIL C
DETAIL B
FRONT BULKHEAD
DETAIL C
FRONT BULKHEAD
DETAIL D
NWHC 7803


DETAIL F
REAR-SIDE BLOCKING ASSEMBLY
THE RIGHT HAND REAR-SIDE BLOCKING ASSEMBLY IS SHOWN. A "RIGHT" AND "LEFT" HAND ASSEMBLY IS REQUIRED
DETAIL E
FRONT-SIDE BLOCKING ASSEMBLY
THE RIGHT HAND FRONT-SIDE BLOCKING ASSEMBLY IS SHOWN. A "RIGHT" AND "LEFT" HAND ASSEMBLY IS REQUIRED
DETAIL H
FILLER ASSEMBLY
(2 REQD)
DETAIL G
NWHC 403

NOTE:

1. THIS DRAWING ... INSTRUCTIONS FOR LOADING SKIDDED UNITS OF 5 ... AMMUNITION PACKED IN WOODEN BOXES IN 20 FT COMMERCIAL CONTAINERS. DETAILS OF THE SKIDDED UNIT ARE ON SHEET 1 OF THIS DRAWING.

2. THE LOAD IS BASED ON ... LONG BY 8' WIDE BY 8'-6" HIGH CONTAINER. CONTAINERS HEAVIER THAN 5,000 LBS CAN NOT BE USED BECAUSE THE RESULTANT GROSS WEIGHT WOULD EXCEED THE PERMITTED MAXIMUM OF 44,80 LBS.

NOTE

8' HIGH CONTAINERS CAN NOT BE USED.

3. THE INTERNAL RESTRAINT SYSTEM KIT (IRSKIT) SHALL BE INSTALLED IN ACCORDANCE WITH NWHC DRAWING NO. 7712. CABLES SHALL BE TENSIONED SUFFICIENTLY TO REMOVE ALL SLACK. JAM NUTS SHALL BE IN PLACE AND TIGHTENED.

4. WHEN THE LOADED CONTAINER IS IN TOFC/COFC SERVICE, ONLY FLAT RAILCARS THAT COMPLY WITH BUREAU OF EXPLOSIVES PAMPHLET 6C SHALL BE USED.

5. THE LOADED CONTAINER SHALL BE ON A 20 FT MILVAN CHASSIS EQUIPPED WITH DOUBLE BOGIES WHEN BEING MOVED IN TOFC SERVICE.

6. THE LOADED CONTAINER MAY BE TRANSPORTED OVER PUBLIC HIGHWAYS ON A PROPER CHASSIS/MODIFIED FLATBED TRAILER THAT ENSURES COMPLIANCE WITH THE WEIGHT LAWS OF THE STATE OR STATES THROUGH WHICH THE VEHICLE IS ROUTED.

7. THICKNESS OF SIDE BLOCKING ASSEMBLY SHOWN IS INTENDED FOR CONTAINERS WITH AN INSIDE WIDTH OF 92 INCHES. A TOTAL OF ONE AND ONE-HALF INCHES OF UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS PERMITTED. FOR NARROWER CONTAINERS, PIECE ..., MAY BE A 1X6 (FOR SIDE BLOCKING ASSEMBLY ON ONE SIDE OF CONTAINER ONLY OR BOTH SIDES OF THE CONTAINER AS REQUIRED TO ACCOMMODATE CONTAINER WIDTHS LESS THAN 92 INCHES. FOR CONTAINERS WIDER THAN 92 INCHES, 1X6 PIECES SHOULD BE LAMINATED ONTO PIECE 11 AS REQUIRED.

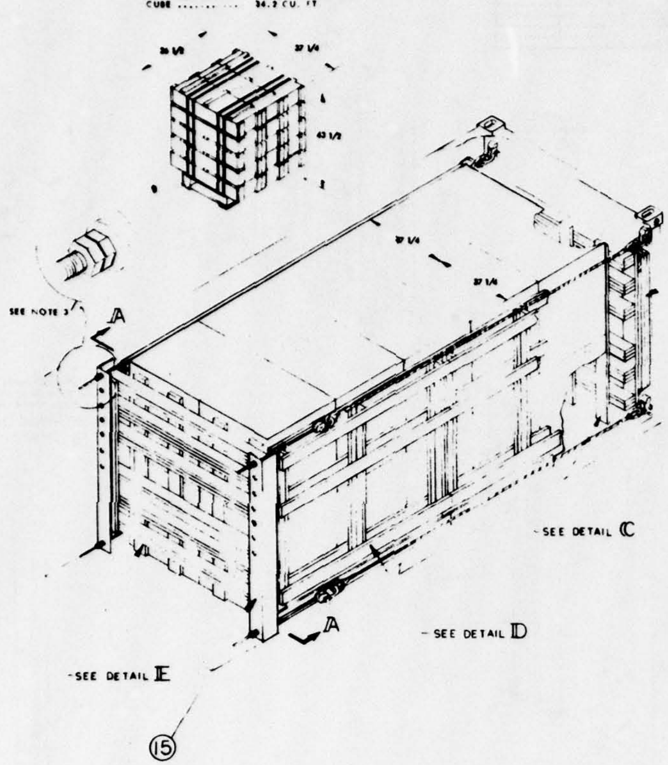
8. APPLICABLE MATERIAL SPECIFICATIONS: DUNNAGE LUMBER, MM-L-751; NAILS, FF-N-105, TYPE II STYLE 1, COMMON BRIGHT.

9. AFTER BLOCKING AND BRACING HAS BEEN INSPECTED, ATTACH SHIPPING DOCUMENTS INSIDE THE CONTAINER IN AN ACCESSIBLE AREA, CLOSE AND SEAL CONTAINER DOORS AND ATTACH "EXPLOSIVES A" PLACARDS TO BOTH SIDES, FRONT AND REAR OF CONTAINER.

CONTAINER LOAD DATA

ITEM	QUANTITY	WEIGHT (APPROX.)
SKIDDED UNIT	20	38,080 LBS.
DUNNAGE (W/IRSKIT)	—	1,720 LBS.
CONTAINER NET WEIGHT (MAX. ALLOWABLE)		5,000 LBS.
(MAXIMUM GROSS WEIGHT)		44,800 LBS.

SKIDDED UNIT
UNIT WEIGHT ..... 1904 LBS (APPROX.)
CUBE .... 36.2 CU. FT.



- SEE DETAIL B

- SEE DETAIL C

- SEE DETAIL D

- SEE DETAIL E

* CW = CONTAINER WIDTH (INSIDE)
** CH = CONTAINER HEIGHT (INSIDE)

PIECE NO.	DESCRIPTION	SIZE OR PART NUMBER	NO. OF PIECES REQ'D	NAIL TO	NAILS NUMBER	NAILS SIZE
15	INTERNAL RESTRAINT SYSTEM KIT (IRSKIT)	NWHC 7712 INSTALLATION DWG	1 KIT			
14	LOAD BEARING PIECE	2 x 6 x 86	4	12	3 PER JOINT	16d
13	VERTICAL	2 x 6 x 70 1/2	2	12	3 PER JOINT	16d
12	REAR BEAM ASSY	2 x 6 x CW-2 1/2 *	10	LAMINATE 3 PIECES	11 PER PIECE	16d
11	HORIZONTAL	2 x 6 x 92	24	10	3 PER JOINT	16d
10	SPACER	2 x 4 x 70 1/2	12	SEE 9 & 11	-	-
9	VERTICAL	2 x 6 x CH-1/2 **	12	10	6	16d
8	TIE PIECE	1 x 6 x 92	4	9	3 PER JOINT	6d
7	LOAD BEARING PIECE	2 X 6 X 86	4	5	3 PER JOINT	16d
6	VERTICAL	2 x 6 x 70 1/2	2	5	3 PER JOINT	16d
5	FWD BEAM ASSY	2 x 6 x CW-1 *	10	LAMINATE 3 PIECES	11 PER PIECE	16d
4	LEG	2 x 4 x 26	2	1	6	16d
3	VERTICAL	2 x 6 x 60 1/2	2	1	5	16d
2	HORIZONTAL	2 x 6 x CW-1 *	2	1	3/JOINT	16d
1	VERTICAL ASSEMBLY	2 x 6 x 71 1/2	6	LAMINATE 3 PIECES	6	16d

LIST OF MATERIALS AND NAILING DATA

ITEM OR FIND NO.	QTY REQ	CODE IDENT NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE

PARTS LIST

NAVAL WEAPONS HANDLING CENTER

20 FT COMMERCIAL CONTAINER LOAD WITH IRSKIT TRAILER/CONTAINER-ON-FLAT-CAR (TOFC/COFC) SKIDDED UNITS OF ... AMMUNITION IN WOODEN BOXES

SMILES 77-10-14

D NWHC7799

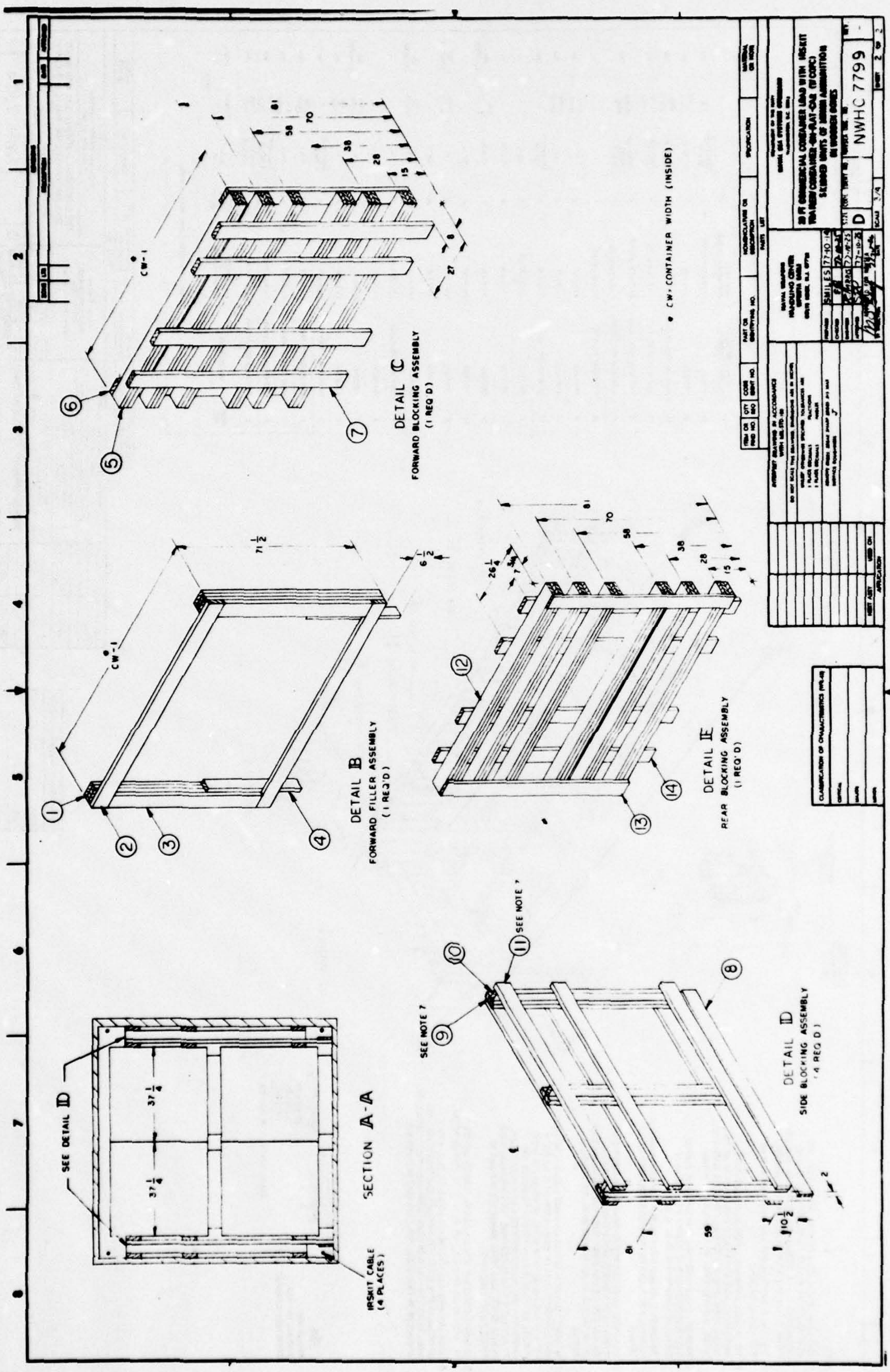
SCALE 1/2 SHEET 1 OF 2

CLASSIFICATION OF CHARACTERISTICS

APPROVED BY

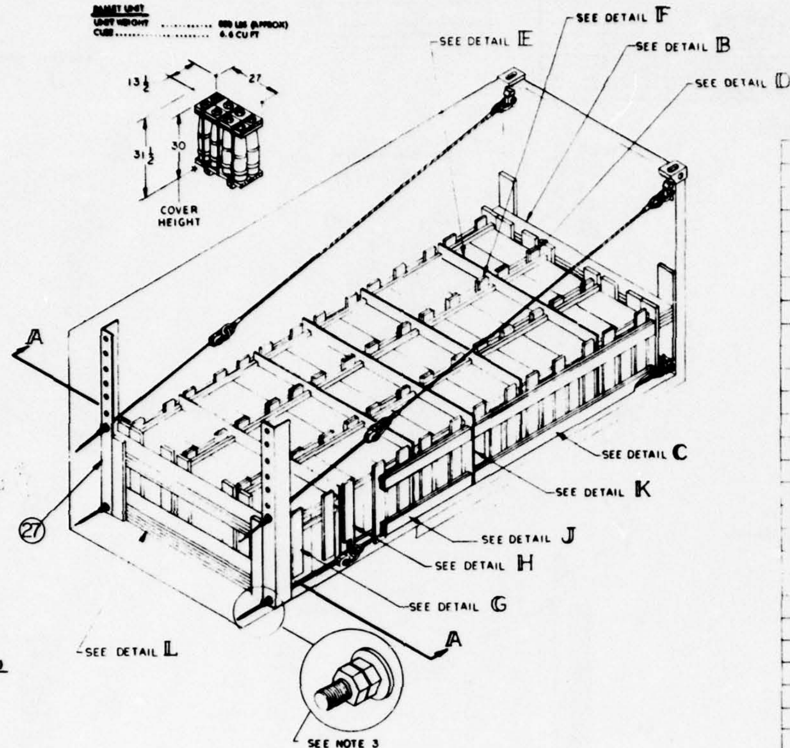
BUREAU OF EXPLOSIVES U.S. COAST GUARD

A-II-4


SEE DETAIL D
SECTION A-A
IRSKIT CABLE (4 PLACES)
DETAIL B
FORWARD FILLER ASSEMBLY
(1 REQ'D)
DETAIL C
FORWARD BLOCKING ASSEMBLY
(1 REQ'D)
DETAIL D
SIDE BLOCKING ASSEMBLY
(4 REQ'D)
DETAIL E
REAR BLOCKING ASSEMBLY
(1 REQ'D)
SEE NOTE 7
* CW=CONTAINER WIDTH (INSIDE)
NWHC 7799

NOTES:

1. THIS DRAWING PROVIDES DETAILED INSTRUCTIONS FOR LOADING PALLET UNITS OF 155 MM SEPARATE LOADING PROJECTILES IN 20 FT COMMERCIAL CONTAINERS. DETAILS OF THE PALLET UNIT ARE ON SHEET 1 OF THIS DRAWING.
2. THE LOAD IS BASED ON A 20' LONG BY 8' WIDE BY 8' OR 8'-6" HIGH CONTAINER.
3. THE INTERNAL RESTRAINT SYSTEM KIT (IRSKIT) SHALL BE INSTALLED IN ACCORDANCE WITH NWHC DRAWING NO. 7712. CABLES SHALL BE TENSIONED SUFFICIENTLY TO REMOVE ALL SLACK. JAM NUTS SHALL BE IN PLACE AND TIGHTENED.
4. WHEN THE LOADED CONTAINER IS IN TOFC/COFC SERVICE, ONLY FLAT RAILCARS THAT COMPLY WITH BUREAU OF EXPLOSIVES PAMPHLET 6C SHALL BE USED.
5. THE LOADED CONTAINER SHALL BE ON A 20 FT MILVAN CHASSIS EQUIPPED WITH DOUBLE BOGIES WHEN BEING MOVED IN TOFC SERVICE.
6. THE LOADED CONTAINER MAY BE TRANSPORTED OVER PUBLIC HIGHWAYS ON A PROPER CHASSIS/MODIFIED FLATBED TRAILER THAT ENSURES COMPLIANCE WITH THE WEIGHT LAWS OF THE STATE OR STATES THROUGH WHICH THE VEHICLE IS ROUTED.
7. THICKNESS OF SIDE BLOCKING ASSEMBLY SHOWN IS INTENDED FOR CONTAINERS WITH AN INSIDE WIDTH OF 92 INCHES. A TOTAL OF ONE AND ONE-HALF INCHES OF UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS PERMITTED. FOR NARROWER CONTAINERS SUBSTITUTE A 1 X 6 PIECE FOR THE 2 X 6 PIECES (5 & 17) AS REQUIRED. FOR CONTAINERS WIDER THAN 92 INCHES, 1 X 6 PIECES MAY BE LAMINATED ON TO PIECES 5 & 17 AS REQUIRED.
8. APPLICABLE MATERIAL SPECIFICATIONS: DUNNAGE LUMBER, MM-L-751; NAILS, FF-N-105, TYPE II, STYLE 10, COMMON BRIGHT.
9. AFTER BLOCKING AND BRACING HAS BEEN INSPECTED, ATTACH SHIPPING DOCUMENTS INSIDE THE CONTAINER IN AN ACCESSIBLE AREA, CLOSE AND SEAL CONTAINER DOORS AND ATTACH "EXPLOSIVES A" PLACARD TO BOTH SIDES, FRONT AND REAR OF CONTAINER.



CONTAINER LOAD DATA

ITEM	QUANTITY	WEIGHT (APPROX)
PALLET UNIT	42	33,600 LBS.
DUNNAGE (W/ IRSKIT)	—	1,482 LBS.
CONTAINER NET WEIGHT (AVE)		5,000 LBS.
	GROSS WEIGHT	40,082 LBS.

CW = CONTAINER WIDTH (INCHES)

PIECE NO.	DESCRIPTION	SIZE OR PART NUMBER	NO. OF PIECES REQ'D	NAIL TO	NAILS NUMBER	NAILS SIZE
27	INTERNAL RESTRAINT SYSTEM KIT (IRSKIT)	NWHC 7712 INSTALLATION DWG.	1 KIT	—	—	—
26	SPACER	2 x 8 x CUT TO FIT	4	TOENAIL TO 22 & 23	3	10d
25	VERTICAL	2 x 8 x 20	2	21,22,23	3 PER JOINT	10d
24	LOAD BEARING PIECE	2 x 8 x 26	8	21,22,23	3 PER JOINT	10d
23	REAR BEAM ASSY, UPPER	2 x 8 x CW-2 1/2	4	LAMINATE 4 PIECES	11 PER PIECE	10d
22	REAR BEAM ASSY, LOWER	2 x 8 x CW - 2 1/2	3	LAMINATE PIECES 21 & 22	10 PER PIECE	10d
21	REAR BEAM ASSY, LOWER	2 x 8 x CW-8 1/2	2			
20	LOAD BEARING GATE	1/2 x 86 x CW-1	1	—	—	—
19	VERTICAL	1 x 6 x 27	2	17	4 PER JOINT	10d
18	VERTICAL	1 x 6 x 20	6	17	4 PER JOINT	10d
17	HORIZONTAL ASSY	2 x 6 x 96	8	LAMINATE 2 PIECES	11	10d
16	TIE PIECE	2 x 3 x 36 1/2	2	SEE 14	—	—
15	TIE PIECE	2 x 3 x 40	2	SEE 14	—	—
14	VERTICAL	1 x 6 x 26	6	15 & 16	3 PER JOINT	10d CLINCHED
13	TIE PIECE	2 x 3 x 27	4	SEE 12	—	—
12	VERTICAL	1 x 6 x 31	4	13	3 PER JOINT	10d CLINCHED
11	TIE PIECE	2 x 3 x 40	20	SEE 10	—	—
10	VERTICAL	1 x 6 x 26	20	11	3 PER JOINT	10d CLINCHED
9	LOAD BEARING GATE	1/2 x 20 x 86	4	—	—	—
8	TIE PIECE	2 x 3 x 27	44	SEE 7	—	—
7	VERTICAL	1 x 6 x 26	44	8	3 PER JOINT	10d CLINCHED
6	VERTICAL	1 x 6 x 20	8	5	4 PER JOINT	10d
5	HORIZONTAL ASSY	2 x 6 x 96	8	LAMINATE 2 PIECES	11	10d
4	FWD BLOCKING PIECE	2 x 8 x 40	8	1 & 2	3 PER JOINT	10d
3	LOAD BEARING PIECE	2 x 8 x 30	8	1 & 2	3 PER JOINT	10d
2	FWD BEAM ASSY, UPPER	2 x 8 x CW-1	4	LAMINATE 4 PIECES	11 PER PIECE	10d
1	FWD BEAM ASSY, LOWER	2 x 8 x CW-9	4	LAMINATE 4 PIECES	9 PER PIECE	10d

LIST OF MATERIALS AND NAILING DATA

ITEM OR FIND NO.	QTY REQD	CODE IDENT NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE

PARTS LIST

CLASSIFICATION OF CHARACTERISTICS

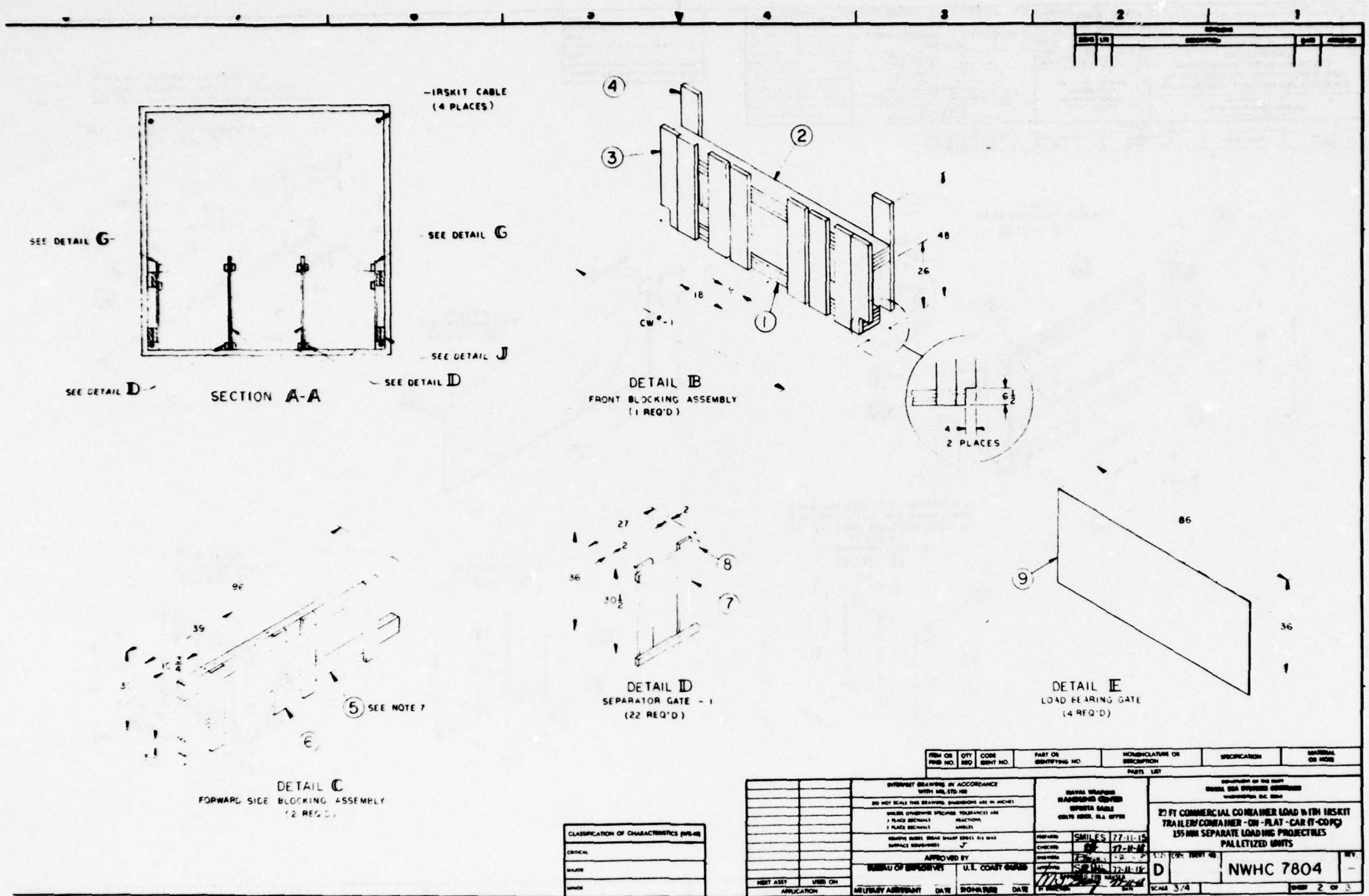
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C.

20FT COMMERCIAL CONTAINER LOAD WITH IRSKIT
TRAILER/CONTAINER-ON-FLAT-CAR (T-COFC)
155MM SEPARATE LOADING PROJECTILES
PALLETIZED UNITS

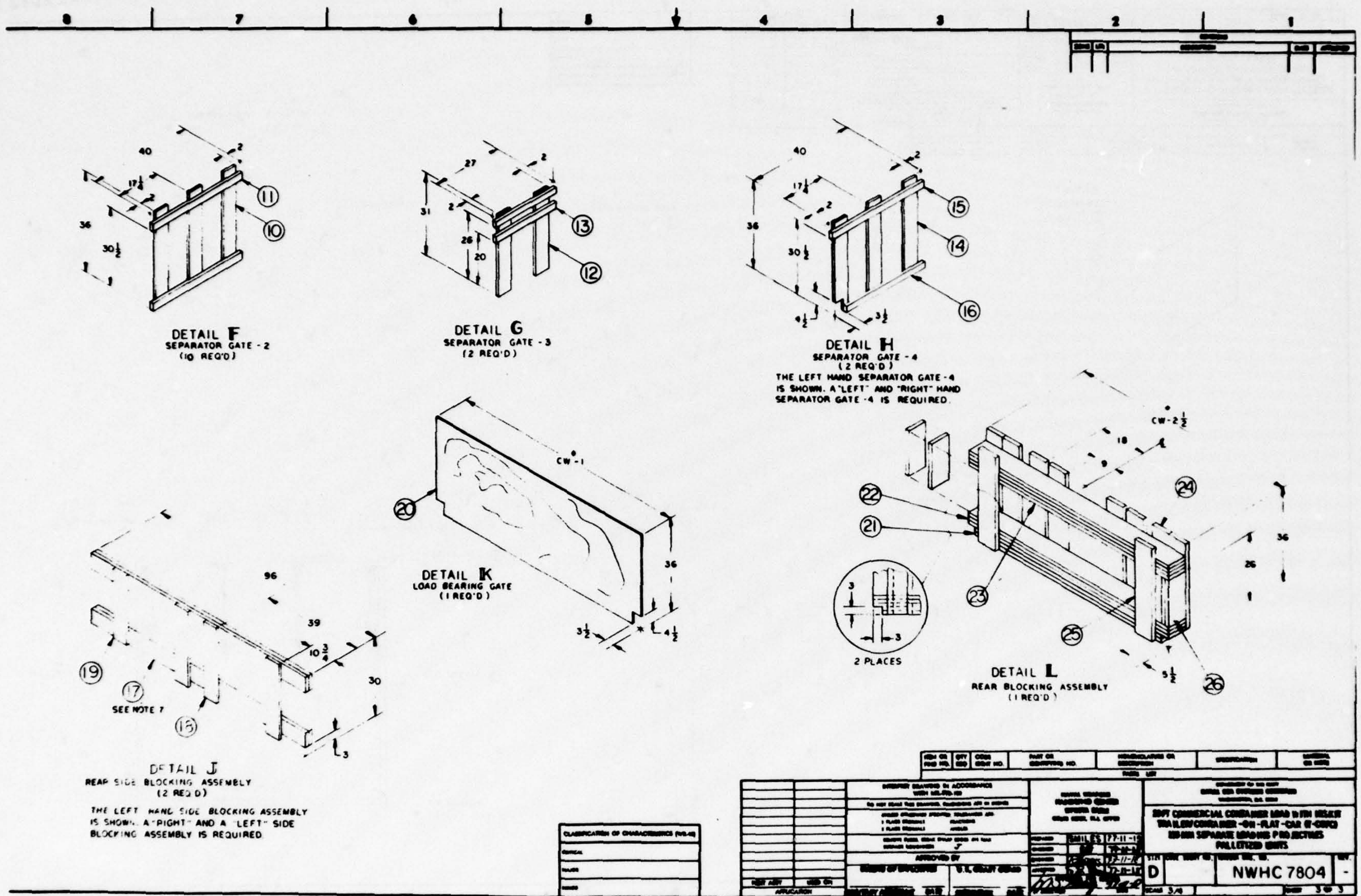
SMILES 77-11-15
77-11-16
77-11-18
77-11-18

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		NWHC 7804	-

SCALE 1/2 SHEET 1 OF 3



IRSKIT CABLE (4 PLACES)
SEE DETAIL G
SEE DETAIL J
SEE DETAIL D
SECTION A-A
DETAIL B
FRONT BLOCKING ASSEMBLY
(1 REQ'D)
2 PLACES
DETAIL C
FORWARD SIDE BLOCKING ASSEMBLY
SEE NOTE 7
DETAIL D
SEPARATOR GATE - 1
(22 REQ'D)
DETAIL E
LOAD BEARING GATE
(4 REQ'D)
CLASSIFICATION OF CHARACTERISTICS
PARTS LIST
APPROVED BY
U.S. COAST GUARD
SMILES 77-11-15
20 FT COMMERCIAL CONTAINER LOAD WITH IRSKIT
TRAILER/CONTAINER-ON-FLAT-CAR (T-COFC)
155 MM SEPARATE LOADING PROJECTILES
PALLETIZED UNITS
NWHC 7804
SCALE 3/4
SHEET 2 OF 3


DETAIL F
SEPARATOR GATE - 2
(10 REQ'D)
DETAIL G
SEPARATOR GATE - 3
(2 REQ'D)
DETAIL H
SEPARATOR GATE - 4
(2 REQ'D)
THE LEFT HAND SEPARATOR GATE - 4 IS SHOWN. A "LEFT" AND "RIGHT" HAND SEPARATOR GATE - 4 IS REQUIRED.
DETAIL K
LOAD BEARING GATE
(1 REQ'D)
DETAIL L
REAR BLOCKING ASSEMBLY
(1 REQ'D)
2 PLACES
DETAIL J
REAR SIDE BLOCKING ASSEMBLY
(2 REQ'D)
THE LEFT HAND SIDE BLOCKING ASSEMBLY IS SHOWN. A "RIGHT" AND A "LEFT" SIDE BLOCKING ASSEMBLY IS REQUIRED.
SEE NOTE 7
CW - 1
CW - 2 1/2
D
NWHC 7804

NOTES

1. THIS KIT IS INTENDED FOR USE IN 20 FOOT INTERNATIONAL ST-NDARDS ORGANIZATION (ISO) COMMERCI-L INTERMODAL CONT-INERS OF STEEL, ALUMINUM OR FIBERGLASS REINFORCED PLYWOOD CONSTRUCTION. CONT-INERS M-Y BE 8 FEET AND 8 FEET 6 INCHES IN HEIGHT.

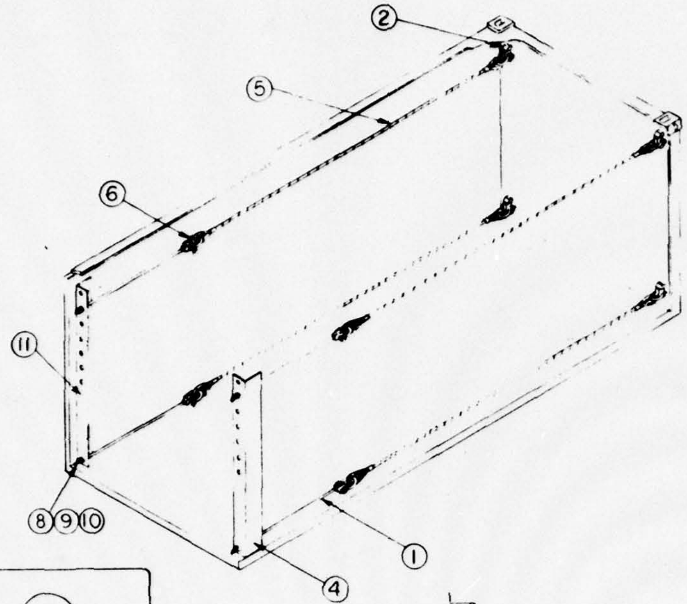
2. THE KIT WHEN INSTALLED AS SHOWN AND USED IN CONJUNCTION WITH OTHER SPECIFIED APPROVED DRAWINGS PROVIDES ADEQU-TE BR-CING FOR SHIPMENT OF AMMUNITION -ND EXPLOSIVES BY ANY SURFACE MODE OF TRANSPORT (MOTOR, R-IL -ND W-TER).

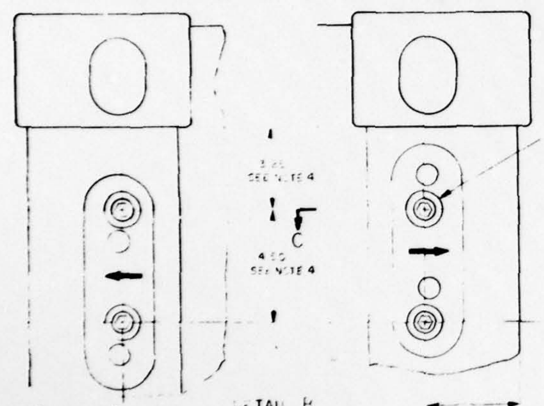
3. WHEN THE CONT-INER H-S FL-T -NGLE CORNER POSTS, LOC-TE -ND DRILL HOLES IN CORNER POSTS AS SHOWN IN DET-IL -. INSTALL W-SHER PLATE, ITEM 3, WITH BEVEL SIDE OUT.

4. WHEN THE CONT-INER H-S CORRUGATED CORNER POSTS, LOC-TE -ND DRILL HOLES IN CORNER POSTS AS SHOWN IN DET-IL B. LOC-TION OF HOLES FROM OUTSIDE EDGE OF CORNER POSTS IS ACCOMPLISHED BY USING WASHER PL-TE, ITEM 3, AS A TEMPLATE. WITH ARROW ON WASHER PL-TE POINTING TOWARD OUTBOARD EDGE OF CORNER POST, POSITION WASHER PLATE IN DEPRESSION OF CORRUGATION AS SHOWN IN SECTION C-C. MARK VERTICAL CENTER LINE OF HOLES USING COUNTERSUNK HOLE IN WASHER PLATE. LOCATE HOLES ON THIS VERTICAL CENTER LINE. DRILL FIRST HOLE 3.25 FROM EDGE OF CORNER BLOCK AS SHOWN IN DET-IL B; ON SAME VERTICAL CENTER LINE DRILL SECOND HOLE 4.50 FROM FIRST HOLE.

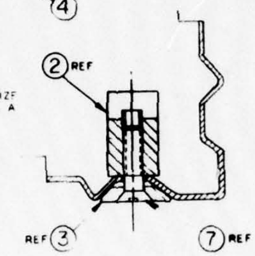
NOTE

ARROW ON WASHER PLATE SHALL BE TOWARDS THE OUTBOARD EDGE OF THE CORNER POSTS IN ALL FOUR LOCATIONS.



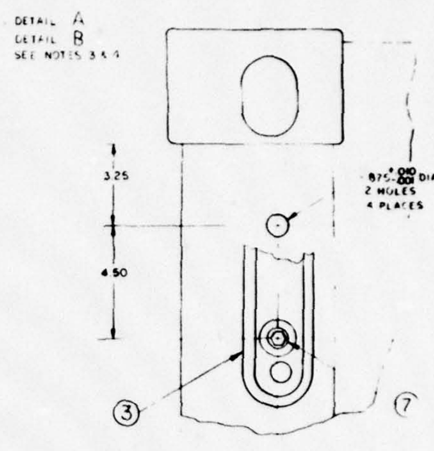


DETAIL B
CORRUGATED CONSTRUCTION
SCALE-1/2



SECTION C-C
SCALE-1/2

DETAIL A
DETAIL B
SEE NOTES 3 & 4



DETAIL A
FLAT ANGLE CONSTRUCTION
SCALE-1/2

ITEM OR FIND NO.	QTY REQ	CODE IDENT NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE
11	1		NWHC 7664-2	ANGLE		
10	4		MS35691-73	NUT, JAM		
9	4		MS51967-29	NUT PLAIN HEX		
8	4		MS27183-27	WASHER		
7	8		MS24667-100	SCREW CAP SOC HD, FL	3/4-10 x 3.00 L	ALLOY STEEL
6	8	[illegible]	2643917-9	SHACKLE		
5	4		NWHC 7713	CABLE		
4	1		NWHC 7664-1	ANGLE		
3	4		NWHC 7661	WASHER PLATE		
2	4		NWHC 7660	SWIVEL FITTING		
1	4		NWHC 7659	ROD ASSEMBLY		

PARTS LIST

CLASSIFICATION OF CHARACTERISTICS

MATERIAL: SEE PARTS LIST

±.03

J.P.S 77-10-3
77-10-14
77-10-25
77-10-25

INTERNAL RESTRAINT SYSTEM KIT (IRSKIT)

INSTALLATION DRAWING

D 53711 NWHC 7712 -

SCALE 1/2 1"

DEPARTMENT OF THE ARMY
US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND AMMUNITION CENTER
SAVANNA, ILLINOIS 61074

REPLY TO ATTENTION OF:

21 NOV 1977

SARAC-DEV

SUBJECT: IRSKIT 12 Transportability Test Data

Commander
US Naval Weapons Station, Earle
Naval Weapons Handling Center
CODE 8021
Colts Neck, NJ 07722

1. Reference 14 November 1977 telephone conversation between Mr. F. Ciccolella of the Naval Weapons Handling Center and Mr. J. Kenna of this Center, subject as above.

2. As was requested in the referenced telephone conversation, inclosed are the instrumentation data that were generated during the rail impact testing of the IRSKIT 12 commercial containers. The reference that was used to locate the restraining cables was the rear or door end of each of the three containers.

3. This information will be repeated and analyzed in the formal report of this testing program. This report will be forwarded when it is published.

4. If additional information is required, contact Mr. J. Kenna at autovon 585-8553.

FOR THE DIRECTOR:

Robert H. Hill for
WILLIAM F. ERNST
Chief, Evaluation Division

3 Incl
as

CONTAINER NO. CTIU 068878

ALUMINUM CONSTRUCTION

39,430 LBS WITH INERT 155MM SLP

IMPACT NO.	IMPACT VELOCITY	BOTTOM LEFT CABLE STRAIN GAGE FORCE	BOTTOM LEFT CABLE STRAIN GAGE DURATION	BOTTOM RIGHT CABLE STRAIN GAGE FORCE	BOTTOM RIGHT CABLE STRAIN GAGE DURATION	TOP RIGHT CABLE STRAIN GAGE FORCE	TOP RIGHT CABLE STRAIN GAGE DURATION	TOP LEFT CABLE STRAIN GAGE FORCE	TOP LEFT CABLE STRAIN GAGE DURATION	CENTER REAR FLOOR DISPLACEMENT GAGE DISPLACEMENT	CENTER REAR FLOOR DISPLACEMENT GAGE DURATION	DYNAMOMETER COUPLER FORCE	DYNAMOMETER COUPLER DURATION
	MPH	LBS	MILLI SEC	LBS	MILLI SEC	LBS	MILLI SEC	LBS	MILLI SEC	INS	MILLI SEC	1000 LBS	MILLI SEC
1	3.68	12700	416	12500	208	14500	364	10800	380	0.40	450	160	110
2	6.52	20700	366	17500	270	22100	400	15700	214	1.25	450	220	110
3	8.72	25800	336	20600	230	27500	420	19300	260	1.80	--	620	90
4(Rev)	8.57	CABLES WENT SLACK								--	--	440	110

CONTAINER NO. C49834

WHITE FRP/PLYWOOD CONSTRUCTION

45,290 LBS WITH INERT 105MM AMMUNITION

		BOTTOM LEFT CABLE STRAIN GAGE		BOTTOM RIGHT CABLE STRAIN GAGE		TOP RIGHT CABLE STRAIN GAGE		TOP LEFT CABLE STRAIN GAGE		CENTER REAR FLOOR DISPLACEMENT GAGE		DYNAMOMETER COUPLER	
	IMPACT VELOCITY	FORCE	DURATION	FORCE	DURATION	FORCE	DURATION	FORCE	DURATION	DISPLACEMENT	DURATION	FORCE	DURATION
IMPACT NO.	MPH	LBS	Milli Secs	LBS	Milli Secs	LBS	Milli Secs	LBS	Milli Secs	INS	Milli Secs	1000 LBS	Milli Secs
1	3.68	15880	507	10000	354	6600	764	10330	280	0.40	430	160	110
2	6.52	16760	346	12250	486	9800	208	15430	299	1.08	440	220	110
3	8.72	17980	344	13000	422	12800	666	13630	240	1.55	370	620	90
4(Rev)	8.57	SLACK IN CABLES								-0.22	350	440	100

CONTAINER NO. CTIU 251425 1

RED CONTAINER OF STEEL CONSTRUCTION

43,610 LBS WITH INERT MK82 BOMBS

		BOTTOM LEFT CABLE STRAIN GAGE		BOTTOM RIGHT CABLE STRAIN GAGE		TOP RIGHT CABLE STRAIN GAGE		TOP LEFT CABLE STRAIN GAGE				DYNAMOMETER COUPLER	
IMPACT NO.	IMPACT VELOCITY	FORCE	DURATION	FORCE	DURATION	FORCE	DURATION	FORCE	DURATION			FORCE	DURATION
	MPH	LBS	MILLI SEC	LBS	MILLI SEC	LBS	MILLI SEC	LBS	MILLI SEC			1000 LBS	MILLI SEC
1	4.21	11600	250	18500	334	15500	245	19900	380			170	75
2	5.58	20700	370	26100	456	19700	284	25600	470			260	90
3	8.45	22500	480	29900	358	19800	278	30300	350			560	80
4(Rev)	8.62	SLACK IN CABLES										390	70

MARINE CONTAINER EQUIPMENT
CERTIFICATION CORPORATION

TEST REPORT

TESTING OF CTI CONTAINER #251-328-1
OUTFITTED WITH NWHC DEVELOPED
INTERNAL RESTRAINT SYSTEM KIT
(IRSKIT)

AT THE REQUEST OF

SUPPLY OFFICER

NAVAL WEAPONS STATION - EARLE

COLTS NECK, NEW JERSEY 07722

TESTING PERFORMED AT

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION

TEST FACILITY

STATEN ISLAND, NEW YORK

FEBRUARY 2, 1978 THROUGH 28, 1978

MCECC FILE C-78032

MCECC FILE #C-78032

On February 2 and 3, 1978, we proceeded to perform stacking, lifting, longitudinal and transverse racking tests at the request of the United States Navy Supply Office, Naval Weapons Station Earle, Colts Neck, New Jersey. These tests were performed in accordance with the ANSI/ISO standards, and were witnessed by Mr. Frank Ciccolella of Naval Weapons Station Earle.

The above mentioned tests were in conformance with a test program outlined in a letter requested by Mr. Ciccolella on August 23, 1977, with additional changes as shown in the following paragraphs.

The stacking test loads were increased from a six-high stacking weight of 100,800 lbs. to a nine-high stacking weight of 161,280 lbs., as it was found that the container which was presented for testing was originally tested and approved for nine-high stacking service.

The transverse and longitudinal racking tests which were originally outlined for a restraint 1.R, or 44,800 lb. load, was increased to a 1.8R load, or 80,640 lb. load; this was done in order to subject both the container and the restraint system (IRSKIT) to the most severe test conditions.

At the conclusion of the stacking test, the restraint system (IRSKIT) was then heavily over tightened in order to subject the front corner posts to a longitudinal bending. The posts were subjected to a concentric stacking load of nine-high, or 161,280 lbs. This was done in order to insure the structural integrity of the container in the event that the restraint system (IRSKIT) was overtightened while the load was being secured.

These tests were performed on a 20'x8'x8'6" steel corrugated container manufactured by TOKYU-CAR Corporation - Container #CTIU 251-328-1, Serial #Y89257 - manufactured in 1977, and leased to the United States Navy by Container Transport International.

The results of these tests are shown in the attached test data sheets.

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, NEW YORK 10301
212-727-6555

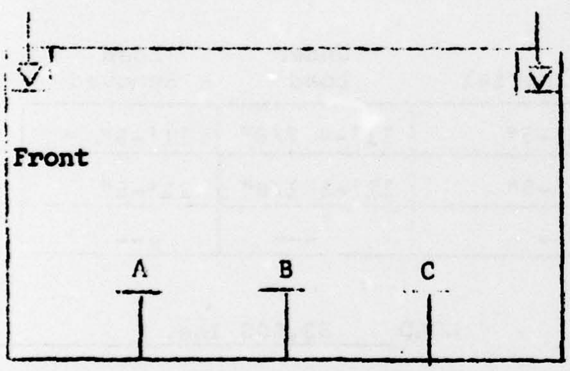
LIFTING FROM TOP CORNER FITTINGS

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y-89257

TYPE 20' 8'x20'x8'x6" Steel DATE OF MFG. 1977

DATE 2/3/78



	Initial	Under Load	Load Removed
A	7/16"	1/2"	7/16"
B	9/16"	5/8"	9/16"
C	9/16"	5/8"	9/16"
D	9/16"	9/16"	9/16"
E	9/16"	5/8"	9/16"
F	9/16"	1/2"	9/16"

INTERNAL LOAD 2R-T = 84,530 lbs.

CENTER C/M DEFLECTION -	---	---	---

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND SECURED
NO PERMANENT DEFORMATION AND/OR DAMAGED NOTED AT THE COMPLETION OF
TESTING.

#163 3/76

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

TRANSVERSE RACKING TEST-FRONT/[illegible]

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8'-6" Steel DATE OF MFG. 1977

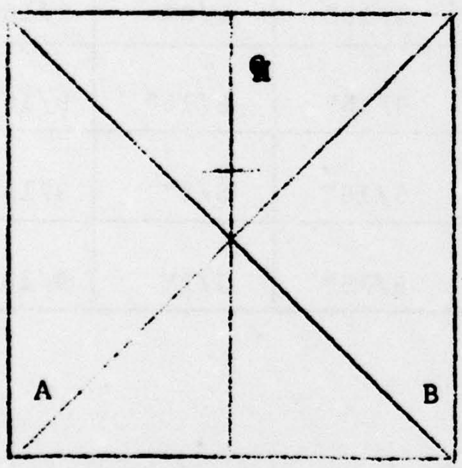
DATE 2/2/78

LOAD 33,600 lbs.

GAUGE PSIG 2,539 PSI

LOAD DIR. PULL TOWARD LEFT

	Initial	Under Load	Load Removed
A	11'-5"	11'-4 7/8"	11'-5"
B	11'-5"	11'-5 1/8"	11'-5"
C	---	---	---



LOAD 33,600 lbs.

GAUGE PSIG 2,539 PSI

LOAD DIR. PUSH - TOWARD RIGHT

	Initial	Under Load	Load Removed
A	11'-5"	11'-4 7/8"	11'-5"
B	11'-5"	11'-5 1/8"	11'-5"
C	---	---	---

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND SECURED. NO PERMANENT DEFORMATION AND/OR DAMAGE NOTED AT THE COMPLETION OF TESTING.

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301

212-727-6555

LONGITUDINAL RACKING RIGHT/[redacted] SIDE

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

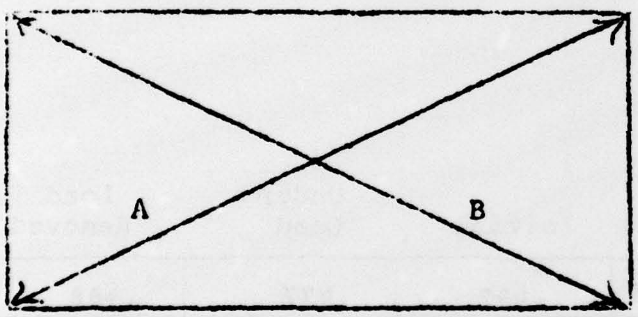
TYPE 20'8'x20'x8'6" Steel DATE OF MFG. 1977

DATE 2/2/78

LOAD 33,600 lbs.

GAUGE PSIG 6,499 PSI

LOAD DIR. PULL TOWARD FRONT



	Initial	Under Load	Load Removed
A	21' 3 5/8"	21' 3 1/2"	21' 3 5/8"
B	21' 3 5/8"	21 3 3/4"	21' 3 5/8"

LOAD 33,600 lbs.

GAUGE PSIG 2,539 PSI

LOAD DIR. PUSH TOWARD REAR

	Initial	Under Load	Load Removed
A	21'-3 5/8"	21' 3 3/8"	21' 3 5/8"
B	21'-3 5/8"	21' 3 1/2"	21' 3 5/8"

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND SECURED. NO PERMANENT DEFORMATION AND/OR DAMAGE NOTED AT THE COMPLETION OF TESTING.

#168-5/76

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8'6" Steel DATE OF MFG. 1977

DATE 2/3/78

CONCENTRIC

	Initial	Under Load	Load Removed
A	.500	.593	.492
B	.500	.467	.486
C	101 7/8"	---	---

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST RIGHT FRONT

ECCENTRIC

1 1/2" forward

1" outboard

	Initial	Under Load	Load Removed
A	.492	.477	.488
B	.486	.469	.485
C	---	---	---

ECCENTRIC

1 1/2" rearward

1" inboard

	Initial	Under Load	Load Removed
A	.488	.570	.492
B	.485	.496	.485
C	---	---	101 7/8"

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND SECURED NO PERMANENT DEFORMATION AND/OR DAMAGE NOTED AT THE COMPLETION OF TESTING

65-5/76

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8'6" Steel DATE OF MFG. 1977

DATE 2/3/78

CONCENTRIC

	Initial	Under Load	Load Removed
A	.500	.558	.522
B	.500	.620	.577
C	101 7/8"	---	---

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST LEFT FRONT

ECCENTRIC

1 1/2" forward

1" inboard

	Initial	Under Load	Load Removed
A	.522	.543	.527
B	.577	.629	.608
C	---	---	---

ECCENTRIC

1 1/2" rearward

1" outboard

	Initial	Under Load	Load Removed
A	.527	.597	.537
B	.608	.690	.640
C	---	---	101 7/8"

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND SECURED
NO PERMANENT DEFORMATION AND/OR DAMAGE

165-5/76

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8'6" Steel DATE OF MFG. 1977

DATE 2/3/78

CONCENTRIC

	Initial	Under Load	Load Removed
A	.500	.546	.500
B	.500	.507	.500
C	101 7/8"	---	101 7/8"

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST RIGHT FRONT

ECCENTRIC

	Initial	Under Load	Load Removed
A			
B			
C			

ECCENTRIC

	Initial	Under Load	Load Remov-
A			
B			
C			

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND OVER TIGHTENED TO SIMULATE THE WORST POSSIBLE CONDITION THE POST MIGHT RECEIVE

165-5/76

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8'6" Steel DATE OF MFG. 1977

DATE 2/3/78

CONCENTRIC		Initial	Under Load	Load Removed
	A	.500	.549	.502
	B	.500	.538	.505
	C	101 7/8"	---	101 7/8"

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST LEFT FRONT

ECCENTRIC		Initial	Under Load	Load Removed
	A			
	B			
	C			

ECCENTRIC		Initial	Under Load	Load Removed
	A			
	B			
	C			

REMARKS: TEST PERFORMED WITH RESTRAINT SYSTEM INSTALLED AND OVER TIGHTENED TO SIMULATE THE MOST SEVERE CONDITION THE POST MIGHT RECEIVE IN SERVICE

165-5/76

MARINE CONTAINER EQUIPMENT
CERTIFICATION CORPORATION

MCECC FILE #C-78032

In concluding our report, we invite attention to the fact that a second series of stacking tests were performed on February 28, 1978. The purpose of these tests was to prove a method of repair to the container's corner posts after the restraint system (IRSKIT) had been removed, and prior to the container being taken off lease. We recommended, based upon industry standards, that the 4 5/8" holes in the left front corner post be plug welded using 7018 filler material. This repair was performed by the Marine Repair Services, Inc. repair facility, located at Staten Island, New York, and the repair was witnessed and inspected by Marine Container Equipment Certification Corporation prior to testing.

The 4 5/8" holes in the right front corner post were left open and unrepaired in order to determine if the corner post would suffer any loss of its structural ability to handle the stacking test requirements, and at the completion of the testing, it was repaired in the same manner as the left post, in order that it could be terminated from lease by the United States Navy.

The results of these tests are shown in the attached test records.

At the completion of all the above mentioned tests, a visual inspection of the container was performed internally and externally, and no deformation and/or damage was noted to have taken place to either the container and/or the restraint system (IRSKIT). We, therefore, on the basis of the test results, formed the opinion that installation of the (IRSKIT) restraint system had no adverse affect on the structural integrity of the container in which it had been installed. Further, it would be our opinion that these tests indicate that a container in good structural condition fitted with this system would be considered safe within the Standards for International Multimodal Transport.

Further to the testing results, it was demonstrated that plug welding of the holes made in the corner post for the installation of the restraint system (IRSKIT) was adequate and sufficient, and that any container properly repaired in this manner could be returned to service and meet ISO and CSC standards for dry van containers.

The above has been submitted as a report and record of individual tests performed on Container Unit #251-328-1, Serial #Y-89257, and includes opinions and conclusions based upon the results of the testing and repairs without prejudice to the rights of all concerned.

MARINE CONTAINER EQUIPMENT
CERTIFICATION CORPORATION

Kenneth C Allen

KCA/tms

KENNETH C. ALLEN
Chief Testing Technician

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8' 6" Steel DATE OF MFG. 1977

DATE 2/28/78

CONCENTRIC

	Initial	Under Load	Load Removed
A	.500	.577	.534
B	.500	.528	.521
C	101 7/8"	---	---

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST RIGHT FRONT

ECCENTRIC

1 1/2" forward

1" outboard

	Initial	Under Load	Load Removed
A	.532	.535	.528
B	.515	.502	.525
C	---	---	---

ECCENTRIC

1 1/2" rearward

1" inboard

	Initial	Under Load	Load Removed
A	.527	.601	.527
B	.523	.574	.530
C	---	---	101 7/8"

REMARKS: TEST PERFORMED WITH THE RESTRAINT SYSTEM REMOVED AND THE FOUR HOLES IN THE POST OPEN

MARINE CONTAINER EQUIPMENT CERTIFICATION CORPORATION
358 ST. MARKS PLACE
STATEN ISLAND, N.Y. 10301
212-727-6555

STACKING

MANUFACTURER TOKYU-CAR CORP. UNIT # CTIU 251-328-1

PURCHASER LEASED TO UNITED STATES NAVY SERIAL # Y 89257

TYPE 20' 8'x20'x8' 6" Steel DATE OF MFG. 1977

DATE 2/28/78

CONCENTRIC		Initial	Under Load	Load Removed
	A	.500	.573	.530
	B	.500	.648	.558
	C	101 7/8"	---	---

INTERNAL LOAD 1.8R=80,640 lbs.

LOAD 9 High=161,280 lbs.

PSIG 7,972 PSI

POST LEFT FRONT

ECCENTRIC		Initial	Under Load	Load Removed
	A	.528	.543	.529
1 1/2" forward	B	.552	.646	.558
1" inboard	C	---	---	---

ECCENTRIC		Initial	Under Load	Load Removed
	A	.528	.586	.531
1 1/2" rearward	B	.557	.659	.563
1" outboard	C	---	---	101 7/8"

REMARKS: TEST PERFORMED WITH THE RESTRAINT SYSTEM REMOVED AND THE FOUR HOLES IN THE POST PLUG WELDED

165-5/76